TEXTILES PAPER LEATHER

AMERICAN DYESTUFF REPORTER

Including the Proceedings of the
AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XI AUGUST 28, 1922 NUMBER 5

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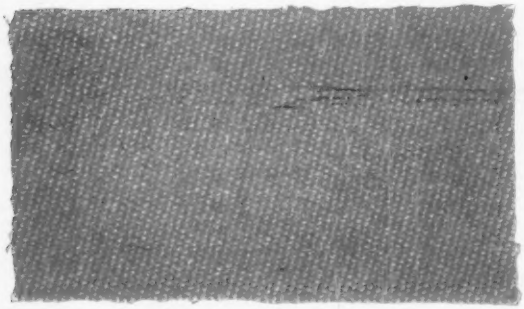
ANILINE COLORS



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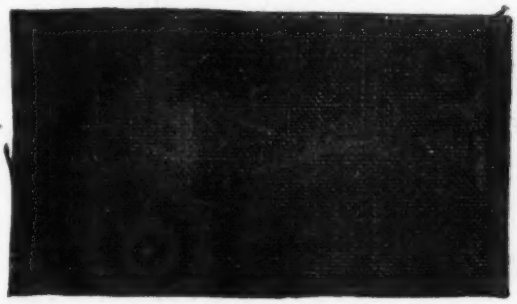

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[Published by the American Dyestuff Reporter in co-operation with The American Association of Advertising Agencies]

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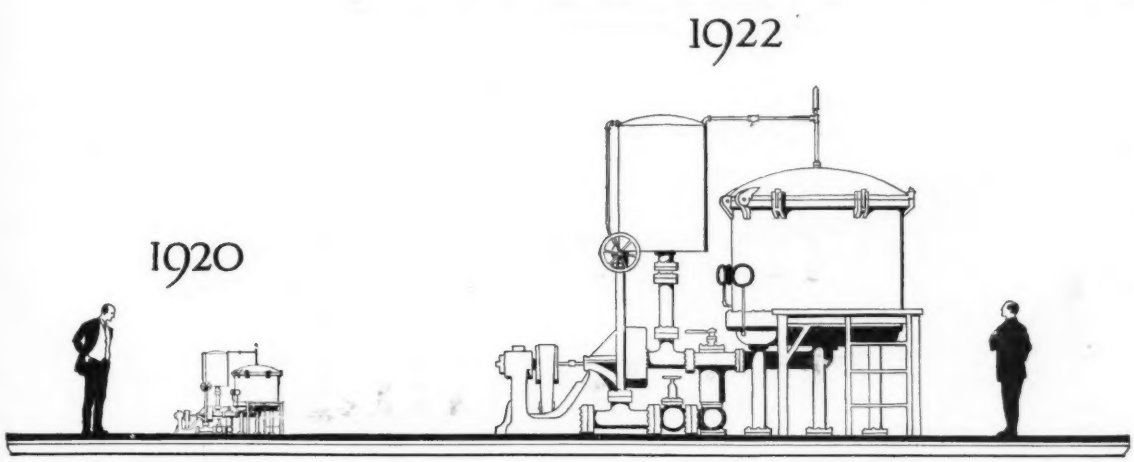

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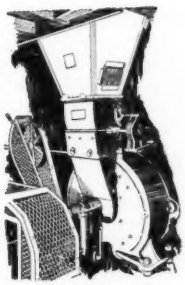

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APRIL 2-6
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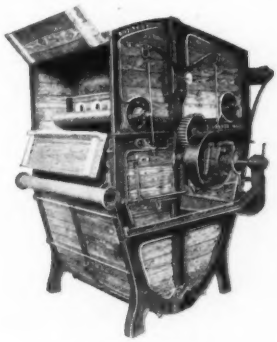

(Ask for Booklet 221)

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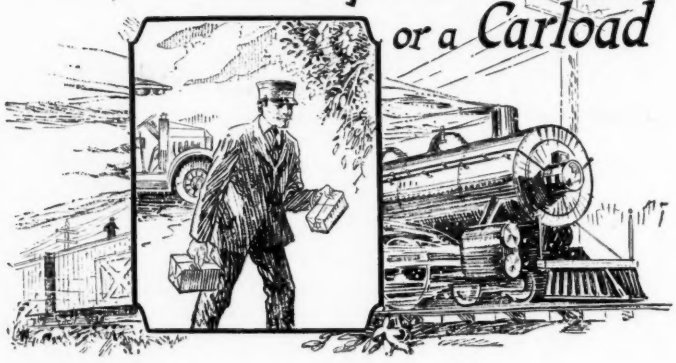

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Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

VOLUME XI | NEW YORK, AUGUST 28, 1922 | NUMBER 5

MORDANTS

In Three Parts—Part I

By WILDER D. BANCROFT

Professor of Chemistry, Cornell University

An Article in the Journal of Physical Chemistry Published at the University and Reprinted by Permission

Note—References will be found at the conclusion of this installment, p. 171

Introduction

In 1875 Napier[1] wrote: "If the various coloring matters used in dyeing had an affinity for the fiber the process would be very simple: it would only be necessary to make a solution of the dye drug and immerse the goods in it to insure their being dyed. But so far from this being the case, if we except indigo and safflower, there is scarcely a dyestuff that imparts its own color to goods; nay, the greater part of the dye drugs used have so weak an affinity, especially for cotton goods, that they impart no color sufficiently permanent to deserve the name of a dye. The cause of this is obvious. If, for example, we take a decoction of logwood, the coloring matter is held in solution by the water; by putting a quantity of cotton into this solution the fibers become filled with the colored solution, but if the cotton has no power to render that coloring matter insoluble, and retain it within its fibers, it is plain that, by taking out the cotton and putting it into water, the coloring matter within and upon it will be diffused in the water—in other words, the dye, having no attraction to the fiber, is washed out. This want of affinity makes dyeing sufficiently intricate and renders it more dependent upon science; indeed, it is only by the nicest arrangement of a few chemical laws that the dyer is enabled to turn to advantage the various coloring matters of which he is in possession. When the dyer finds that there is no affinity between the goods and any coloring substance which is put into his possession, he endeavors to find a substance which has a mutual attraction for the cloth and coloring matter, so that by combining this substance with the cloth, and then passing the cloth through the dyeing solution, the coloring matter combines with the substance which is upon the goods, and constitutes a dye. This third substance used, which acts as a mediator, combining two inimical bodies, is termed a mordant, from the French *mordre*, to bite—from an idea which the old dyers had that these substances bit or opened a passage into the fibers of the cloth, giving access to the color. And although the theory of their action is now changed, the term is still continued and perhaps further investigation will prove the term not altogether inapplicable."

In the first English book on dyeing, Bancroft distinguished between substantive and adjective colors.[2] "To me, however, coloring matters seem to fall naturally under two general classes; the first including those matters which, when put into a state of solution, may be fixed with all the permanency of which they are susceptible, and made fully to exhibit their colors in or upon the dyed substance, without the interposition of any earthy or metallic basis; and the second, comprehending all those matters which are incapable of being so fixed, and made to display their proper colors, without the mediation of some such basis. The colors of the first class I shall denominate 'substantive,' using the term in the same sense in which it was employed by the great Lord Verulam, as denoting a thing solid by, or depending only upon itself; and colors of the second class I shall call 'adjective,' as implying that their luster and permanency are acquired by their being adjected upon a suitable basis."

Bancroft's views on mordants[3] are practically those held many years later by Napier. "Adjective coloring matters are generally soluble, in a great degree at least, by water; though some of them derive their solubility from an intermixture of what has been called 'extractive' matter; which being separated in the dyeing process, after the adjective color has been applied

to the dyed substance, their union becomes thereby more intimate and permanent. But in other respects, adjective colors owe their durability, as well as their luster, to the interposition of some earthy or metallic basis; which, having a considerable attraction, both for the coloring matter and the stuff to be dyed, serves as a bond of union between them, and obviates that disposition to suffer decomposition and decay, which naturally belongs to such coloring matters when uncombined. These earthy and metallic bases, having been commonly employed in a state of solution or combination with acids, were from that circumstance denominated mordants (biters or corroders) by the French, who, indeed, began to employ the term long before anything like a true theory of dyeing had been conceived; whilst even alum was supposed to act by its sulphuric acid, and not by the pure clay upon which its usefulness depends, and whilst in truth all the other matters called mordants were supposed to be useful only by their solvent or corroding powers; and the term, having been thus employed, has been since adopted in other countries. The ingenious Mr. Henry, of Manchester, has, however, lately objected to it, with great reason, and proposed in its stead to employ the term 'basis,' which seems defective only inasmuch as it does not express the particular affinity, or power of attraction, manifestly subsisting between these earthy and metallic substances, and the several adjective coloring matters, as well as between the former and the fibers of wool, silk, cotton, etc. I confess, however, that no other more suitable term has occurred to me: and being unwilling to propose new terms, without some cogent reason, I shall sometimes employ that of mordant as well as that of basis; though not indiscriminately in all cases; since I shall generally use the former to signify earthy and metallic substances when actually dissolved by some acid, alkaline or other solvent, and when of course they will commonly prove more or less corroding or biting, according to the original meaning of the term. But the denomination of basis will be most frequently used to designate the same earthy and metallic substances, distinctly and separately from any acid or other solvent, when actually fixed in the pores or fibers of wool, silk, etc., or when it is not intended to notice any property in them, which may more immediately result from their combinations with any particular menstruum. M. Berthollet, indeed, gives the term mordant a much more extensive signification, as meaning all the different chemical agents capable of serving as *intermedia* between the several coloring particles and the stuffs so dyed with them, either for the purpose of assisting their union, or of modifying it. This last effect (or modification) may, however, be produced by a variety of matters besides those which are of the earthy or metallic kinds, and indeed by everything capable, not of fixing, but of merely varying the shades of adjective coloring matters. These, therefore, I think it more proper to designate, not as mordants or bases, but as 'alterants' whose use and application may in this respect be extended to substantive as well as to adjective colors."

A mordant is thus a substance which is adsorbed strongly by the fiber and which adsorbs the dye strongly. If one is a purist, it is necessary to say that adjective colors dye the mordant and not the fiber; but nobody does this, because the difference can only be detected by careful microscopic observation.[4]

The word mordant has prevailed over Bancroft's word, basis, so far as the dyeing industry is concerned; but the latter term has survived in the paint trade, where we speak of the carriers for lakes as bases,[5] this having nothing to do with the chemist's use of the word to denote an oxide or hydroxide. In fact, a particular precipitated barium sulphate[6] has been given the trade name of Lake Base because it was "of great value as a base upon which to precipitate lakes."

At the present time we distinguish acid and basic mordants, the tannins and the so-called oils being the acid mordants,[7] while the hydrous oxides of the heavy metals are classed as the basic mordants. This distinction is a comparatively recent one, for the basic mordants used to be considered as practically the only ones.[8]

"All the mordants, with one or two exceptions, are found among the metallic oxides. It may be supposed from this that, as metals are the most numerous class of elements, mordants are also very numerous; it is not so, however. In order that the substance may act as a mordant, it must possess certain properties: it must have an attraction for the coloring matter, so as to form with it an insoluble colored compound; and it must be held easily in solution in order to enter within the fiber. It may also have an affinity for the fiber, a tendency to unite with it, but this property is not essentially necessary; only the two first properties are so, and they limit the mordants almost wholly to what are termed the insoluble bases—that is, substances which are not by themselves soluble in water.

"The bases or oxides which are in general use as mordants, and which appear to succeed best, are alumina and the oxides of tin and iron; the two first are colorless, and the peroxide of the latter is brown, and imparts to white goods a buff or nankeen color; which in many cases affects to a considerable extent the color of the cloth, a circumstance which must also be attended to by the dyer. Indeed, the principal part of all dyeing operations is the proper choice and application of mordants; there being a chemical union between them and the coloring matter, a new substance is formed, not only differing in properties, but differing in color, from any of the originals, consequently a very little alteration in the strength or quality of a mordant gives a decided alteration in the shade of color. However, this gives the dyer a much wider field for variety of shades, and at the same time a less

number of coloring substances are required; as, for example, logwood alone gives no color to cotton worthy the name of a dye; yet by the judicious application of a few different kinds of mordants, all the shades from a French white to a violet, from a lavender to a purple, from a blue to a lilac, and from a slate to a black, are obtained from this substance.

"The property which the fiber possesses of fixing portions of the dyestuff within its pores will have to be often referred to, as it bears a very important relation to mordants. What are termed astringent substances have a strong action in this way in combining with the fibers of cotton goods. A piece of cotton put into a hot solution of sumach, and remaining in it until cool, there is a quantity of the astringent principle, probably gallic or tannic acid, fixed upon the fiber which no washing will remove. We have seen goods thus treated passed afterwards through all the regular operations of bleaching, and still retaining so much of these substances as was sufficient to impart a black tint on passing them through protosulphate of iron. Hence the astringent matters in many vegetable dyes act a very important part in the dyeing operations. Whether such substances as galls and sumach, which are used only for their astringent principle, may be termed mordants is a question we need not discuss, but they are essentially necessary for fixing within the fiber such quantities of the metallic base or mordant as are required to give depth and permanency to the color; and as these astringent matters produce tints with the bases, they give a wider scope for variety of color. Thus, if we pass a piece of cotton through a solution of protochloride of tin, and then wash it in water, we will have a great quantity of oxide of tin fixed within the fiber by the operation of washing; and by passing this cloth through a decoction of Brazil-wood, and then 'raising' with a little spirits, there is a fine though not permanent rose-red produced. If we pass the cotton through bichloride of tin, and then wash, there is very little of the oxide of tin fixed; for the bichloride is not decomposed, as the protochloride is, by water. If, then, it is passed through the Brazil-wood in the same manner as the other, a color of less depth is produced; but if the cloth be previously steeped in sumach, and be then passed through the tin solution, even the bichloride, the astringent principle of the sumach combines with the tin and forms an insoluble compound; and there is thus fixed a great quantity of the metallic base within the fiber, which gives the color with the Brazil-wood, so that, when immersed into the wood decoction, there is obtained a color of great depth and permanency. But the compound formed between the tin and sumach gives a yellow, and thus peculiar tints of the color are obtained; instead of having a rose color, as was obtained without the sumach, a deep rich red, between rose and scarlet, is produced. Thus sumach, galls, etc., are extensively used, in connection with metallic bases, to fix, modify and impart depth to colors for which these bases are applied. The nature of these astringent substances will be given under the distinctive names of the matters which contain them."

While the oxides of aluminum, tin and iron were practically the only basic mordants in use in Napier's time, chromic oxide is probably to-day the most important of all the mordants, unquestionably so for wool. Nearly all possible oxides have been studied at one time or another. Liebermann[9] reports on experiments with the oxides of aluminum, antimony, beryllium, bismuth, cadmium, cerium, chromium, cobalt, copper, iron, lead, manganese, nickel, thorium, tin, uranium, yttrium, zinc and zirconia. Titania[10] is used as mordant on leather hat-bands. Alumina was the first mordant used, and in the old days the oxides of aluminum and tin were the most important, with iron oxide a poor third, because people were interested in obtaining bright colors. Nowadays the oxides of chromium and aluminum are the important ones, with the oxide of iron a fair third and the oxide of tin a poor fourth. The possibility of using other oxides had been considered more than a century ago, for Bancroft[11] says: "It will be ascertained hereafter, by my own particular experiments, that all the metals, properly so called, as far as they have been tried, are capable of attracting adjective coloring matters in some degree, and of serving as bases to them; and this is also true of most of the earths; though none of them is so efficacious and useful in this way as alumine; indeed, this and the oxide of tin seem to be the only bases suited, by their perfect whiteness, to reflect the rays of light so as to exhibit adjective colors with their utmost luster and brightness, every other falling short of these in that respect, and almost all of them appearing to sadden or darken the colors which they serve to fix. Probably the oxides of zinc and antimony do this less than any of the others; the former, however (zinc), does not appear, by my experiments, capable of giving much stability and permanency to any color dyed with it."

Until near the end of the fifteenth century the alum used for dyeing in Italy came from the Turks, there being an alum works near Constantinople and a famous one near Smyrna.[12] "About the year 1460, Bartholomew Perdix (by some called Pernix), a Genoese merchant who had become acquainted with the preparation of alum in Syria, when returning thence to Italy, happened, at the island of Aenaria, now called Ischia or Hiscla, to observe large alum stones among the substances which had been thrown up, more than one hundred years before, in consequence of the eruption of a destructive volcano there; and, having calcined some of these stones in a furnace, he extracted from them excellent alum." Pure alum was apparently given the additional appellation in Italy of *rocca* or *roccha*, when come the French name of *alun de roche* and the English one of roach alum.

A few years after Perdix had begun to produce alum from the stones which he found at Ischia, the famous deposit at Tolfa near Civita Vecchia was discovered by John di Castro. The account of this throws such a light on the trade in the heavy chemicals in those days that it is worth quoting [13] in spite of its having nothing to do with the theory of mordants.

"This John di Castro, being fond of traveling, had resided some time at Constantinople, and acquired much wealth by dyeing cloth made in Italy, which was transported thither and committed to his care, on account of the abundance of alum in that neighborhood. Having by these means an opportunity of seeing daily the manner in which alum was made, and from what stones, or earth, it was extracted, he soon learned the art. When, by the will of God, that city was taken and plundered, about the year 1455, by Mahomet II, Emperor of the Turks, he lost his whole property; but, happy to have escaped the sword of these cruel people, he returned to Italy, after the assumption of Pius II, to whom he was related, and from whom he obtained, as an indemnification for his losses, the office of commissary-general over all the revenues of the Apostolic Chamber, both within and without the city. While in this situation he was traversing all the hills and mountains, searching the bowels of the earth; he at length found some alum stones in the neighborhood of Tolfa; and having made experiments by calcining them, he obtained alum, and repairing to the pontiff, said to him: 'I announce to you a victory over the Turk. He draws yearly from the Christians above three hundred thousand pieces of gold, paid to him for the alum with which we dye wool of different colors, because none is found here, but a little at the island of Hiscla, formerly called Aenaria, near Puteoli, and in the cave of Vulcan at Lipari, which, having been exhausted by the Romans, is now almost destitute of that substance. I have, however, found seven hills, so abundant in it that they would be almost sufficient to supply seven worlds. If you will send for workmen sufficient, and cause furnaces to be constructed and the stones to be calcined, you may furnish alum to all Europe; and that gain which the Turks used to acquire by this article being thrown into your hands, will be to him a double loss, etc.' These words of Castro appeared to the pontiff as the mere results of idle dreams. He, however, employed skillful people, who found that the stones really contained alum; but least some deception might have been practised, others were sent to the place where they had been found, who met with abundance of the like kind. Artists who had been employed in the Turkish mines in Asia were then brought from Genoa; and these, having closely examined the nature of the place, declared it to be similar to that of the Asiatic mountains, which produce alum; and, shedding tears for joy, they kneeled down three times, worshipping God and praising his kindness in conferring so valuable a gift on our age. The stones were calcined, and produced alum more beautiful than that of Asia, and superior in quality. Some of it was sent to Venice and to Florence; and being tried, was found to answer beyond expectation. The Genoese first purchased a quantity of it, to the amount of twenty thousand pieces of gold; and Cosmo, of Medicis, for this article laid out afterwards seventy-five thousand. On account of this service, Pius thought Castro worthy of the highest honors, and of a statue, which was erected to him in his own country, with this inscription: 'To John di Castro, the inventor of alum'; and he received, besides, a certain share of the profit; immunities and a share also of the gain were granted to the two brothers, Lords of Tolfa, in whose land the aluminous mineral has been found. This accession of wealth to the Church of Rome was made, by the divine blessing, under the Pontificate of Pius II; and if it escape, as it ought, the hands of tyrants, and be prudently managed, it may increase, and afford no small assistance to the Roman pontiffs, in supporting the burthens of the Christian religion."

"The wealth which the Pope obtained from the discovery and working of the mines of Tolfa, encouraged and produced similar undertakings in other parts of Italy, particularly at Volterra, in the district of Pisa, though their success was greatly obstructed by the obstacles which the Pope contrived and employed against them, in order that he might monopolize all the benefits to be derived from the manufacture and sale of alum; of which he raised the price so exorbitantly, that alum procured from the Turks was found much cheaper than that of Tolfa, and, therefore, employed. But to obviate this interference, the Pope pretended to devote the revenue produced by his alum work to the defense of Christianity against the Turks, and menaced all who should act so unchristianly, as to purchase or procure alum from these infidels, with excommunication; which prohibitions were renewed by several of his successors."

"In England the first alum work was that of Gisborough, in Yorkshire, begun near the end of Queen Elizabeth's reign, upon lands belonging to Sir Thomas Chaloner, who secretly procured workmen from the alum works at Tolfa, no person in England then knowing how to produce it. This seduction of his workmen so enraged the Pope, as we are told by Pennant, in his Tour to Scotland, that his holiness endeavored to frighten and recall them, by curses, or anathemas, in the very form left us by Ernulphus."

Bancroft [14] states that "this alum continues to be known under the name Roman alum and esteemed above all others; principally because it contains about half as much iron as most other alums; the latter, however, may be rendered equally pure and valuable by calcining, then dissolving, and afterwards recrystallizing them. Stahl, Newman, Pott and other eminent chemists consider alumine as a calcareous earth, and

not as being an earth, which it is, *sui, generis,* nearly related to clay, but differing from it."

According to Bersch,[15] under the name of Roman alum, "or that of 'cubical alum,' a variety of alum is sold, generally at a rather higher price than ordinary alum, from which it is distinguished by its crystalline form. Ordinary alum forms octahedral crystals often the size of a child's head, but cubic alum well-formed cubes. The property of crystallizing in cubes may be imparted to any alum solution by the addition of a little potash.[16] Much so-called Roman alum is made in German works in this way. When this alum contains very little iron, it is quite equal in quality to the best Roman alum, for the higher value of the latter is due entirely to its low content of iron. The alum prepared in the province of Naples is still better than Roman alum; it contains less iron."

We are so familiar with metallic aluminum and so accustomed to look upon Sir Humphrey Davy's preparation of the alkali metals as one of the great discoveries of the period that it is rather a shock to learn that this view was not shared by all of his contemporaries.[17]

"I have, in the course of this work, commonly adopted the language and, with a few exceptions, the principles or explanations of modern chemistry, not as being wholly unobjectionable but as according best with known facts, and being most likely to become parts of a more perfect system, when future discoveries shall have laid a sufficient foundation for the construction of one. I have not, however, been convinced of the expediency of adopting some of the opinions promulgated by Sir Humphrey Davy; though I hope and believe that I am properly disposed to admire his extraordinary talents and acknowledge the important additions made by him to chemical science. This is not the place to discuss, and, therefore, it would be improper to dispute any of his facts; but I hope it may not be deemed improper for me to mention a few of the objections to which some of his conclusions seem liable.

"He supposes himself to have proved that the fixed alkalies (and several of the earths) are metals combined with oxygene, or, in other words, metallic oxides; and that when the oxygene has been separated by the powerful agency of opposite electricities, from the bases of these alkalies, the latter are reduced, each to its proper metallic state, and though the supposed metallic globules so produced cannot be retained in this state for a single minute without burning, and again becoming potash and soda, and are besides much lighter than water, he has thought it right to consider and arrange them as metals, under the names of potassium and sodium.[18] He (Sir H. Davy) admits that 'a considerable degree of specific gravity was formerly considered as an essential character of metallic substances, but (he adds) I have discovered bodies lighter even than water which agree in all other essential qualities with metals, and which consequently must be arranged with them.' See 'Elements of Chemical Philosophy,' p. 319. How it should follow that bodies which agree with metals in all but one essential character must be arranged with them I am unable to conceive; for to my understanding, an opposite inference seems the most natural, and, indeed, the only allowable one. But is it true that the bodies in question do really possess all the other character which are deemed essential to the constitution of a metal? Is not the strong propensity of potassium and sodium to burn instantaneously in the air, and as instantaneously to decompose water, without acquiring in either case the properties of metallic oxides, at variance with all former ideas of the nature and essential character of a metal? Even the shining quality of these supposed metals, which more than anything else seems to give them a metallic appearance, belongs equally to petroleum, when diffused upon the surface of water, and to indigo when dissolved for topical application by calico printers, as is hereafter described. Sir H. Davy has admitted (p. 321 of his Elements) that 'the common metals, in consequence of their fusibility, malleability, hardness and durability, have been the most important insrtuments of the arts'; and that 'the uses of them have been essential to the progress of civilization': after such an admission, it may, I think, be reasonably asked why they are to be confounded with matters which have none of these characters.

"Surely, if it be expedient (which I do not perceive) to comprehend things so dissimilar, under one common or general denomination, it would be much more convenient to invent a new name for that purpose and allow us to designate matters of such high importance as the metals, properly so called, by that which has been so long appropriated to them. To confound, by one appellation, substances so unlike each other, as those commonly called metals, earths and salts, must be highly inconvenient for the ordinary purposes of life, as well as for the operations of human intellect; and it must be no small addition to the evils of this confounding to have it extended even to water, and to that fluid of which our atmosphere chiefly consists, nitrogene; both of which, as a consequence of these doctrines, are to be deemed metallic oxides (i. e., of hydrogene). It cannot, I think, be necessary for the advancement of science that we should thus perplex our language and ideas, and subvert those distinctions which have long regulated the actions and opinions of mankind; and I have, therefore, abstained from these innovations in the following pages. There is, indeed, an additional reason for not considering in this work the alkalies as metallic oxides; which is, that their effects in dyeing are as opposite as possible to those of the oxides of metals, properly so called: and in regard to alumina (or the earth of alum), which is supposed to contain a peculiar metal, called by Sir H. Davy 'aluminum,' I must declare that the evi-

dence of probability of its existence appears to me much more feeble even than that which regards the supposed metals of the alkaline earths; which last, in my judgment, is far from being sufficient to warrant his arrangement of them in the class, and under the denomination, of metals."

It is worth noting that Bancroft uses the word aluminum and not aluminium. Davy [19] says in one place that if he had succeeded in isolating the metal he was going to call it alumium; but he actually does call it elsewhere [20] aluminum. Graham [21] uses the same spelling, while Silliman [22] writes aluminium, though adding that "aluminum would seem preferable, but I adopt the orthography already introduced." The truth of the matter seems to be that aluminum is the proper English spelling, analogous to platinum, stannum and glucinum, while aluminium is a later and German version.

The earlier experiments on the mordanting of wool and with aluminum sulphate or with alum do not seem at all in accord with what we now find; but the discrepancy is more apparent than real. According to Bancroft [23]: To impregnate wool or woolen cloth with aluminous basis, it is commonly boiled in water, with from one-fourth to one-sixth of its weight of alum, and from one-twelfth to one-sixteenth of its weight of crude tartar, putting the latter first into the water, and, afterwards, the powdered alum: the heat of the water, being gradually raised, is kept at the boiling point for an hour and a half, or two hours, during which the cloth is turned through the boiling liquor on a winch, that the mordant may be equally applied; and being afterwards taken out and drained, it is commonly left until the next day, and then rinsed in clean water, for dyeing. In the early collection of recipes, printed in 1605, and already mentioned, sour bran liquor is commonly directed to be employed in this way with alum; and it seems to have answered the purpose of tartar, which, when it came to be generally used in this way with alum, was supposed by the older dyers to do good by softening and correcting the acrimony of the latter: probably, however, the purposes which it answers are not yet clearly ascertained; one of them seems to be that of increasing the solubility of alum and enabling it more completely and intimately to penetrate the fibers of the wool, with which it moreover enters into a permanent union and thereby contributes efficaciously to modify, vary and in some cases to brighten the colors with which it is employed, as will be seen hereafter.

"It was until very lately believed, even by those who had most knowledge of the subject, that woolen cloth boiled in this way, with alum, decomposed the latter, in a considerable degree at least, attaching to itself the alumine, though not without a small portion of the sulphuric acid in combination therewith.[24] Very recently, however, MM. Thenard and Roard (of whom the latter is director of the dyeing department at the imperial manufactory of the Gobelins at Paris) appear to have acquired more correct ideas on this point by a series of experiments, of which they have given a minute statement in a memoir read at the Physical and Mathematical class at the French National Institute (see Ann. de Chimie tom., 74, p. 267 [1810]).

"These experiments were principally made with alum, acetate of alumine, tartar and the solutions of tin, applied to wool, silk and cotton; and by these it was fully ascertained that alum and cream of tartar do not decompose each other when dissolved in water and boiled with wool (a fact which had, indeed, been previously asserted by Berthollet); that in this boiling, the wool combines with the alum without decomposing it in any degree,[25] and also with the tartar; that equal parts of alum and tartar would dissolve in two-fifths less of water than would be required to dissolve them separately.

"They found that wool, as it is commonly cleansed for being alumed, was not deprived of the carbonate of lime naturally combined with it; and that this wool being boiled the usual time, with one-fourth of its weight of alum and one-sixteenth of its weight of cream of tartar, rendered the bath or water, troubled or muddy, and produced (as is, indeed, commonly observed) a copious white sediment, which being collected, washed, and analysed, was found to consist chiefly of a sulphate of lime, and a saturated sulphate of alumine. That when wool had been properly cleansed, and deprived of its carbonate of lime, no sulphate thereof was found. Such wool or cloth, being boiled in pure distilled water, with the proportions just mentioned of alum and tartar, and the bath or liquor with which the boiling had been performed being carefully evaporated, a residuum was found, consisting of alum, cream of tartar, and a compound, difficultly crystallizable, of tartrite of potash and animal matter. The wool itself, when so boiled, afforded, by repeated washings, alum, and a small quantity of cream of tartar, besides a very sour combination of tartaric acid, alum, and animal matter. As the acid of tartar combines so copiously with wool, MM. Thenard and Roard have inferred, that it ought not to be employed in this way with alum, except for colours which acids contribute to raise and improve: and among such colours they rank those of cochineal, kermes, and madder; but those of weld, logwood, and Brasil wood, not resisting acids as they suppose, wool, intended to be dyed from either of these, ought, as they think, to be alumed, without any addition of tartar. The accuracy of these opinions will be tried by facts when the several colouring matters here mentioned shall claim our particular attention."

Napier [26] quotes the following theory of mordants by M. Dumas:

"Cream of tartar, or bitartrate of potash, constitutes by itself a feeble mordant, but which is very often

(*Continued on page* 169.)

Why Silk Dyers Should Insist on a Report on the Quality of Raw Silk

Not Knowing What You Buy Is Bad Practice—Dyers Unable to Prevent Hairiness and Lousiness if Not Informed—Putting the Blame Where It Belongs—Abuses Which Result from Failure to Have Tests Made

By L. C. LEWIS

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Haphazard Methods

RAW silk is the most valuable material used in the manufacture of textiles, yet it is surprising how few manufacturers make tests of this same material which they spend some $300,000,000 for each year. The average manufacturer merely picks up his telephone receiver, calls up a raw silk importer and, after discussing prices for a while, orders his raw silk. In doing so he depends entirely upon the importer to deliver to him the grade of silk which he pays for—and this is exactly what he gets; for, when he beats the importer down ten or fifteen cents per pound he should not expect the grade ordered.

The silk manufacturer then sends the silk to the throwster and has it thrown into two or three thread organ, or three, four, five, six, seven, eight, nine, ten or twelve-thread tram. On account of the rereeling of the Japanese silk, most of it runs well on winding, especially if the silk is soaked, which removes the hard gums which cause most of the breaks in the throwing plant during winding. The very fine ends all break during the winding, and when the silk comes to the spinning and doubling processes it is raised one or two qualities and gives the throwster very little trouble.

The Dyer Must Work in the Dark

The silk is then sent to the dyer in skeins to be dyed, and the dyer, not knowing whether the silk is a Double Extra or a No. 1, with a high cohesion or low cohesion, puts it through his regular boil-off weighting and dyeing processes. When the silk is dried and finished, the dyer in many cases finds the silk very hairy and occasionally lousy; and he does not know whether the fault was in his own dyeing or in the raw silk. If he had had a comprehensive report from a reliable testing company, he would, on the other hand, be able to tell very soon whether or not the fault was his. Raw silk with a high cohesion will boil off and dye without showing any signs of hairiness, while raw silk with a low cohesion will be hairy after these operations.

Who Is to Blame?

If the dyer does not report this lousy condition to the manufacturer, the latter discovers it when he winds and weaves the silk. First of all he blames the dyer for this hairy or lousy silk; but if he had had in his possession a trustworthy report on his raw stock, he would have known at once whom to blame.

There seems to be little question but that the methods of inspection now in vogue at Yokohama are antiquated. The writer recently tested a 20/22 denier silk being sold by an importer in the New York market as a Best No. 1 to Extra. This tested a No. 1 and was a very low-grade silk with lots of very fine, and fine and coarse, ends; large knots, slugs, bad throws, corkscrews, loops, nibs and a low cohesion. A perusal of the inspector's report showed it to be a very good one, though not indicative of the graded silk the importer in question was selling.

Abuses Result from Absence of Tests

American silk manufacturers should have all their raw silk tested by a reliable laboratory, reject the silk that is not up to the standard paid for, and send a copy of the report to the dyer. As long as the silk importers can sell a No. 1 silk as a Double Extra, and so get 50 cents more per pound—which on a five-bale lot means $325 extra—they will do it.

Subjoined is a quotation from the "Textile American" under the heading "Standards of Quality" which appears to be pertinent:

"Probably at no other time in the history of the silk industry has the quality of a fabric been of greater importance. Starting at the time of the buyers' strike in 1920, the preference of the consumer for the products of mills which have established a quality for their fabrics has become increasingly evident.

A Pertinent Paragraph

"A paragraph in one of the recent numbers of 'Textile World' emphasizes this point so clearly that the liberty is taken of quoting it:

" 'One of these days manufacturers and merchants are going to wake up to the fact that the buyers' strike against high prices is not to be broken by the offering of inferior merchandise.

" 'Some of the most noteworthy successes in a generally unsuccessful season have been in mills with unusually high-grade fabrics, while in other instances firms whose prices seem to be within the ideas of the purchasers have had hard sledding.' "

Dyeing Worsted Fabrics

Scouring the Pieces and Further Preparation for Dyeing—Quantity of Dye Liquor—Matching the Sample —Steam Supply—Temperature Control—Dissolving Dyestuffs—Washing—Pastel Shades—Matching Competitors' Shades

By LOUIS J. MATOS, PH.D.

AFTER worsted cloth has been woven and the cuts correctly marked with the yardage, piece and lot numbers, it is made ready for scouring.

The degree of scouring depends considerably upon the quality of the oils used in the preparation of the stock for carding and spinning. The ideal oil to use for the finer qualities of wool is, without doubt, olive oil, but there have been introduced to the trade a number of other oils, mostly compounds, that scour out quite easily, and which leave the pieces in an open and free condition, and without any residual odor. This latter point is also important because in times past many otherwise excellent fabrics were defective, due to the ever-present odor of oils of some sort that resisted action of even strong scours.

Scouring the Pieces

Worsted piece goods should be scoured carefully with a clean soap solution that may be fortified with a small amount of ammonia, not exceeding 2 pounds for each 100 pounds of cloth. The scour bath should always have a slight lather, and the operation should be continued until the scour boss is assured that all oils are thoroughly dissolved. No definite time can be indicated for this operation, and only the experience gained in handling similar lots will serve as a guide. The temperature of this scour should be kept as low as possible, but not permitted to rise above 120 deg. Fahr.

After the scouring, rinsing should be followed with ample clean, soft water. The necessity for soft water is apparent, and for well-known reasons. Should the wash water contain lime, this latter substance will combine at once with the soap remaining in the pieces, forming insoluble lime soaps which adhere tenaciously to the cloth, and which cannot be removed by any subsequent operation without inflicting some injury. Many defects in cloth, such as streaks and off-shades, may be traced to the presence of lime soaps.

From the scour, the better qualities of worsted piece goods are carbonized to remove any vegetable fibers present. The most commonly employed process is based upon the use of oil of vitriol, and is as follows: The fabrics are passed through the carbonizing sour standing at 8 deg. Tw. until saturated, then evenly squeezed through a nip and fed into the stove, heated from 180 to 195 deg. Fahr. When thoroughly baked and all the vegetable fibers have been destroyed, the pieces are run over stiff brushes to clean them, when they are ready to be neutralized by passing through a weak solution of carbonate of soda, and afterwards thoroughly washed.

Further Preparation for Dyeing

Carbonizing machines are of various types, but nearly all operate upon the same principle. The vat containing the dilute acid should be lead-lined. The guide rollers are made of hard rubber. The squeeze rollers should be well covered with hard rubber, and always adjusted for even pressure. While accidents will occur, the piece should not be allowed to come in contact with the lead lining of the vat, on account of the thin coating of sulphate of lead on its surface, which, if rubbed off by the pieces, will later show up as streaks or spots. Lead sulphate acts as a resist for a number of wool dyes, and is thus directly responsible for uneven results. The continuous carbonizing machine and dryer for cloth offers numerous advantages and is coming to be generally used.

After carbonizing and neutralizing, the pieces are ready for bleaching or dyeing without bleaching. If they are to be dyed light shades, bleaching becomes necessary to increase the brilliancy. Formerly, worsteds were bleached by the sulphur house method, which gave good results, but its operation was at all times disagreeable to those directly in charge of it. At times, however, it was responsible for hundreds of pieces that were injured through the deposit of sulphur, which could not be satisfactorily removed.

Bleaching Process

Peroxide bleaching and bisulphite bleaching have almost completely taken the place of the older process, giving results that are always uniform and above criticism. The bisulphite process should be carried out in a separate building or in a room separated from the main dyehouse. A stock solution of bisulphite of soda is prepared, standing at 7 deg. Tw. To prepare the bleach bath, run in about 1,000 gallons of water and add 20 to 25 gallons of the above stock solution; stir well and add 22 to 30 pounds of oil of vitriol previously diluted with water. Mix the bath thoroughly.

Enter the extracted but not dry pieces, and work over the winch for about one hour, or until they are saturated, and afterwards allow them to remain im-

mersed in the solution until they have been bleached sufficiently. They are then removed from the bleach bath and well washed in water containing about 15 pounds of oil vitriol for each 1,000 gallons of water, followed by a good rinse. The pieces are then ready for dyeing.

Peroxide of hydrogen bleaching is carried out with either peroxide of hydrogen directly in a slightly alkaline bath, or peroxide of sodium is added to a weak bath of oil of vitriol in suitable proportions, and then made alkaline with silicate of sodium. In either case the bleaching results are excellent, and leave the cloth in a most satisfactory condition.

Quantity of Dye Liquor

After the goods have been bleached by whatever process is adopted, they are ready for the dyer. If the cloth is to be dyed very light shade the dyer should use kettles that are not employed for medium or heavy shades, and should see to it personally that they are well scrubbed out and washed before the dye bath is made up.

Economically, it is the best practice to dye as many pieces of one shade as the kettle will conveniently accommodate, but not to overload it, keeping in mind the practical working proportion of 300 gallons of water for each 100 pounds of cloth. If this proportion is greatly exceeded there will be a tendency toward streaks and other kinds of unevenness. To save some time the dyer may open the steam cock during the filling of the kettle, but the temperature should not be allowed to rise much above 160 deg. Fahr. before the pieces are put in. After the acid and Glauber's salt have been added and a portion of the estimated quantity of dye, previously dissolved, has been poured in, the steam is again turned on and the dyeing continued at the boil until the proper depth of shade has been secured.

Matching the Sample

In most instances, even with standard colors, shading or toning becomes necessary toward the end of the operation, and here is where the skill of the dyer shows itself most. Dyeing of light pearls, grays, smokes and other colors that require for their production the addition of several dyes are at times very troublesome to bring up to an exact match; even with the best judgment of the dyer, half an ounce of one of the shading dyes is likely to throw the final shade a trifle off.

Of course, much depends upon how close the dyer is held to his sample. We all like to have exact matches, but there are times when such perfection is seemingly impossible to reach. Even in cases where the match has finally been made upon the identical material that is to be used on a large scale, and a formula adopted, there will arise local conditions that prevent the mixture of dyes giving exactly the same tone.

Slight changes in the quality of the water used in a dyehouse have a greater influence on delicate shades than any one other cause, while the constant temptation to change the source of supply of soap in a mill is likewise responsible for some defects. Changing supplies during the run of a season's line causes more trouble for the dyer than probably anything else.

Every dyer has experienced the disagreeable result where six or eight pieces of apparently the same cloth have been dyed at the same time, with a properly adjusted mixture of dyes, of having one or two of the pieces show up differently from the others after they have gone through the finishing operations. Such instances are not the fault of either the dyer or the dye, but the trouble is to be looked for in the treatment the off-shade pieces had before going into the dye tub. In the majority of such cases the real trouble is due to making up lots with one or two additional pieces of a very similar but not identical cloth. Dyeing full shades offers less difficulty in matching, since minor differences in tone are not so apparent to the eye.

Steam Supply to Kettles

Steam supply to the kettles is important, and the supply must be at all times ample to enable the dyer to keep his baths always under control. The steam inlet pipes and distributors should be clean and open, so that the bath may be evenly heated. In old kettles the distributors are frequently found clogged with loose fibers and bits of thread that have been sucked back through the steam holes as the steam in the pipe has condensed, affording no outlet for the steam when the kettle is next used.

When this has occurred in the middle of the kettle, the end pieces get the benefit of some of the direct steam and are often overdyed in streaks, while it is not uncommon to see some of the center pieces quite even but slightly lighter in shade. When the weight of the pieces is too much for the winch to drag and the volume of water in the kettle below normal, the action of direct steam in causing unevenness is marked.

Maintaining Even Temperature of Bath

Proper maintenance of an even temperature in the dye bath is becoming more and more recognized as a factor in good dyeing. Most mode shades are dyed with two or more dyes, and in the nature of things there are hardly two different dyes that possess identical properties, including the property of being taken up from the bath at the same rate of speed. For this reason, many dyeing recipes clearly indicate the extremes of temperature between which effective dyeing is accomplished. It therefore becomes desirable that

the temperature of the dye bath should be maintained at a definite point and held there by some accurate means other than that of requiring the dyer to have a thermometer in one hand and his other hand on the steam valve. Automatic temperature regulators are available for this purpose and are finding an increased use.

In dyeing all shades it is desirable to enter the pieces in the bath before in the dye, but in most mills the dyer starts off with some of the dye and adds the necessary remainder as the dyeing progresses. When the dyes used are "level dyeing" and require actual boiling, this close regulation of temperature will not be necessary; but with other dyes that go on the cloth quickly, both the dyes and the acid should be fed in gradually.

Dissolving Dyestuffs

Some dyes are more soluble than others, a property that requires that the dyes used should be completely dissolved in hot water before adding to the dye bath. It is not sufficient to weigh out the proper quantity of dye, place it in a buck, pour water upon it, then insert a steam pipe and bring it to the boil, trusting that such a procedure will cause every particle to dissolve. The hot solution should be passed through a fine cloth strainer to hold back any undissolved color. The necessity for this is particularly urgent in the use of dyes for topping, especially where faced or napped goods are dyed.

The proper way to dissolve dyes is to have a few 5-gallon tilting steam-jacketed copper kettles. This equipment enables the dyer or his second hand to see that all the dye has actually gone into solution. Such copper vessels are much superior and convenient to work with than the usual galvanized pail common in nearly every dyehouse.

Method of Washing After Dyeing May Cause Creases

After dyeing, the pieces must be well washed. The usual practice is to pull the plug, run off the spent liquor, and wash in the same kettle. It is a question whether this practice is not responsible for many blemishes noticed on fine piece goods after being finished. The writer believes that it is. It seems preferable to allow warm water to run into the kettle while the dye liquor is being run off, thus gradually lowering the temperature; then follow with a full head of cold water. By this means the tendency of rapidly chilling the folded cloth and "setting" the creases is minimized. Wool cloth that is hot while in folds and creases retains the marks where the folds were if suddenly cooled, and it is with great difficulty that the finisher can eradicate them.

Dyeing Pastel Shades

Very light and delicate shades, known generally as "pastel shades," must be dyed upon bleached cloth with acid dyes, together with oxide of zinc or fine chalk. The cloth is dyed with Glauber's salt and oil of vitriol in the usual manner, using about half the required quantity of dye; afterward rinse and bring up to the full shade with a further amount of dye, together with a small quantity of oxide of zinc ("zinc white") or chalk. This second dyeing is done in a cold bath and with dyes that have a relatively strong affinity for wool.

Another method for producing this line of shades is to add zinc white or chalk to the cold bath and work through squeeze rollers for ten to fifteen minutes, afterward adding the dyestuff and working for an additional half-hour. Then wash well and dry on a tenter.

It may be noticed that "chalk" and dyestuff are used together, which may cause some readers to recall that the presence of lime in water causes a certain loss of dye. In dyeing pastel shades this is true, and the dye-chalk (or lime) compound that is formed and held in fine suspension in the dye bath gradually becomes more or less firmly attached to the wool fibers and results in producing the desired shade. It is not a dyeing in any sense of the word. The use of any colored lake will produce similar results. Indeed, some fabrics have been "dyed" by means of oil paints dissolved in volatile solvents, leaving the pigments on the goods.

Difficult to Match Competitors' Shades

Mills undertaking to produce a line of pastel shades on their own goods should confine their effort to the shades they establish rather than attempting to match their competitors' shade. Matching pastel shades is difficult.

Ordinary worsted fabrics for both men's and women's wear are dyed chiefly with fast acid dyes or dyes that require after-treatment with chrome mordants. The former practice of first mordanting the cloth is slowly but gradually being abandoned. This is due to the extension of the line of dyes that can be "fixed" by adding chrome to the dye bath during the dyeing or to the spent dye bath.

Many worsteds are now woven in immense quantities containing cotton or silk effect threads. These threads may be undyed so as to show up white in the finished cloth, or they may be dyed suitable colors. As a rule they are "registered"; that is, prepared so as not to take up any of the dye when the cloth is dyed. Or the dyes selected for the cloth are such that they do not stain the silk or cotton.

In dyeing such effect pieces on a large scale it is necessary to work with little acid and at as high a temperature as possible, inserting a supplementary steam

supply pipe for the purpose. Should the silk be slightly overstained it may be cleared by adding to a fresh bath a small amount of oxalate of ammonia. Usually, however, the staining of the silk is due to the presence of lime in the water.

Many worsteds, especially faced goods, must be crabbed. For the better qualities too much care cannot be given to this operation, since uneven winding on the rolls or other unevenness will cause surface blemishes that no amount of labor can remove. Folds and laps in rolling should be particularly guarded against, since they will show very distinctly when the pieces are thrown over the perches.

At every stage in the process of the goods from the loom to the finishing room care in mechanical handling and thorough washing between processes are to be insisted upon. For fabrics that are to be made up into garments to be sold at popular prices it is possible to take chances and allow certain operations to be performed with less strictness as to details, but where a high quality of mill output is insisted upon every care must be exercised.—"Posselt's Textile Journal."

Some Recent Important Developments in Artificial Silk

Employment of Finer Apertures in Spinning Colloidal Solutions—Concentration and Method of Feed—By-products of Viscose—The Acid Spinning Bath—A Drying Process

THE idea of producing practically artificial fibers which might perhaps some day supplant those of the silkworm is due to Count Hilaire de Chardonnet, who has been called the father of the artificial silk industry. To him we owe the nitro-cellulose process, which he published in 1884. This process was the first to be used on an industrial scale and was prevalent throughout the "nineties." The close of the nineteenth century saw the industrial adoption of the cuprammonium process by Bronnert, Fremery, and Urban. Following hard upon these two processes are those of the viscose and more recently the viscose improved processes.

The use of artificial silk may be said to be as yet in its infancy, and from day to day fresh uses are discovered for its products. They tend to incerase as cheaper processes are evolved. The silk as it was originally manufactured, owing to this factor of cost, has only been able to be used to advantage along with other textile fibers, such as cotton, and in these cases the fiber preponderating has not been the artificial silk. It is only now that artificial silk alone is being used in the manufacture of articles on a large scale. The present fashion has been of much use to the industry, for it has been possible to use the silk in the manufacture of ties, jumpers, stockings, underclothing, and articles of a similar nature, without the admixture of other fibers.

A New Development

A new step has been taken in the production of artificial viscose silk. Until now artificial silk, for a variety of reasons, has only been produced of a count varying from eight to ten deniers, while the double thread of the silkworm is of two to three deniers. It has always been a complaint among consumers of artificial silk thread that manufacturers appeared to be unable to place a thread of the fineness of natural silk on the market. A French inventor and artificial silk manufacturer has now supplied this need in a most remarkable manner.

Colloidal solutions of cellulose, like viscose, are spun by the well-known process of forcing them through fine apertures. The apertures were required to be smaller in the case of a fine thread and larger in the case of a coarse thread. More concentrated solutions of cellulose were required to obtain stronger threads. Concentrated solutions of cellulose, on the other hand, required narrower openings because of their high content of cellulose. However, the difficulty in filtering the solutions in order to prevent a rapid choking and the boring of the apertures, as well as the increased pressure required, are all causes of an irregular spinning, and operated therefore against a higher concentration. Hitherto an average good spinning of eight deniers has been accomplished, with a solution containing 8 per cent of cellulose, and with apertures of 0.1 mm. diameter.

The Fine Thread

The employment of finer apertures occasioned only more difficulties, and among other attempts one of drawing off rapidly the thread as it was produced and of less feed of viscose to the nozzles proved quite unsuccessful. Many were the attempts made to solve this problem of the fine thread. Now, however, it has been shown that under certain conditions threads of two to three deniers and less may be spun with the greatest regularity and ease. The same size of apertures may still be used and the same maximum spinning speed of forty-five meters per minute may be continued. The two factors of this important improvement are the feed of viscose to each aperture in relation to a unit of time, and a minimum percentage of acid different for each count is necessary in the spinning

bath. Below this minimum spinning of this count is impossible. It is a well-known fact that a rapid exhaustion of the acid spinning bath took place in the case of the former eight deniers threads, when the flow of the alkaline viscose running through an acid bath had neutralized the acid to a greater or less degree. But until now it has not been known that for each count a special and strictly limited minimum concentration was required, in conjunction with an appropriate feed, and that it was possible to retain the usual nozzle of 0.1 mm. by using, for example, the ordinary viscose as used by ripening the alkaline cellulose first and then the viscose solution itself to a certain degree of maturity.

In this new process for fine spinning, maintaining the minimum concentration for each count is so important that no lower count can be spun with regularity than that of the particular thread for which it is adapted. There is a certain relation between the counts of the single thread and the concentration of the acid in the spinning bath, and this has been reduced to a rule and named by Professor Bronnert the "Square-Root Law." The square roots of the different counts are inversely proportional to the concentration of the acid in the bath. The minimum concentration for an eight deniers thread is, as already known, 140 grams of monohydrated sulphuric acid per liter. For this new spinning process no change need be made in machinery and the output remains unaltered, and any count may be spun with the apparatus by the mere conforming to conditions according to the square-root law.

Brilliancy in the fine counts may be varied at will and without any damage to the strength of them. To reduce brilliancy and to obtain an opaque thread it is only necessary to lower temperature, whereas by raising the temperature to 40 or 50 deg. Cent. a thread of more and more brilliancy is produced. The new viscose has a very soft touch and a much-increased covering power, dyes evenly, and when woven does not easily crease.

By-products of Viscose

Methods have been put forward for the recovery of the products in the viscose process. In the cuprammonium process a recovery of about 90 per cent of the ammonia and 95 per cent of the copper has been effected without excessive expense. The soda lye in the viscose until now had been wasted, after having been neutralized by the sulphuric acid of the spinning bath. It had been suggested to recover sulphate of sodium from the spinning bath by cooling it and so causing a dissociation of the bisulphate in the spinning bath into neutral sulphate and sulphuric acid. This method, however, was faulty and most expensive. The fact is that the sulphates produced do not remain in the spinning bath, but are formed only on the threads emerging from it and received on the spools or the like. Threads, as a rule, are only slightly acid when the acid has penetrated the thread and entirely neutralized the alkali of the viscose. In washing with water the process of removing the neutral salts from the inner parts of the threads takes a long time and much water is required.

The finer threads require a more acid salt bath and acid and salt have to be added continually. In a new Bronnert process water acidulated with sulphuric acid is employed to such an extent that all sulphate in the threads is converted into the easily soluble bisuplhate, which may easily be washed out on the addition of more sulphuric acid.

After using the same restricted quantity of acidulated water twice an equilibrium is produced between the content of bisulphate in the threads and that in the liquid. A further washing would not extract more of the salt, and so the threads are squeezed out and the liquid falling from them collected. After concentrating to a certain degree the hot strong acid, bisulphate of soda is added again to the spinning bath, instead of adding fresh sulphuric acid and neutral sulphate or bisulphate as was formerly done.

This process has proved most economical and gives the best result when mixed ammonium and sodium salts are used together with the spinning bath.

The Acid Spinning Bath

A spinning bath of pure acid yields threads with an irregular round cross section. The same occurs when acid is in excess over salt in the spinning bath. The section differs completely when the salt is in excess and produces the form of a star with serrated outlines. If the salt is in great excess the thread appears to be coagulated more slowly and takes the form of a bean, the serrated outline being nevertheless maintained. It is caused by a shrinkage which forces the water out of the inner parts of the thread into the surrounding salt solution. It is possible to observe from these characteristic forms which process has been used in the spinning, and it is also most important for the specific luster of the thread. The angular bulbs act like prisms to the light and increase or decrease the transparency of the threads. A higher temperature of the spinning bath hastens the plasmolytic process, shrinkage takes place in a different way, and different effects are produced.

In spinning from ammonium salt with a little acid, threads are produced of a perfect round circumference, and although these have a slightly less covering power they are of even transparency and brilliancy and of the highest tensile strength, which makes them suitable for use in braids and the like.

A great variation has been found in the strengths of even first-class artificial silks, especially when dry. This may be caused by the irregularity of the cross sections and by defective spinning, and may be brought about in the following way: It has been found that the apertures become choked not only when impurities owing to bad filtering are in suspension in the viscose, but also when the minimum concentration necessary for the special

counts does not exist at each aperture. This becomes worse when some of the apertures are choked, and other apertures producing coarse threads owing to the additional feed of viscose. It is most important, therefore, to have the bath circulating and of constant composition and temperature. In the best silk resulting from one kind of viscose, when all the spinning factors are carefully arranged, the filaments all show the same even section section. This may be realized in the acid wet spinning process with the greatest ease and better than in the Chardonnet process when spinning collodion direct into hot air.

The short fiber received fresh impulse by the above described improvement of Professor Bronnert. It may be spun to any count, and when it is fine may be mixed with schappe to a certain degree or may be spun alone with a yarn resembling schappe yarn. These yarns at the same weight naturally exhibit a greater volume than the hanks of artificial silk yarn, even when they are of the same count. Although the luster partly disappears during the combing operation articles manufactured from the new mixed or unmixed yarns have a remarkable "feel" and brightness, and if possible to be produced at a low price and on a large scale they may prove of great assistance to the textile industry.

A Drying Process

Processes have been further cheapened by another Bronnert process. It is a well-known fact that the usual way of drying gelatinous freshly precipitated and washed cellulose threads had to be carried on with extreme care. When the threads were placed too near to the steam pipes or radiators, producing the higher temperature, the threads became brown, and the cellulose was altered, which meant that only relatively low temperatures could be employed and, of course, the drying process took much longer. Much room is required and the cost of fuel is excessive. Until now the drying temperatures employed scarcely exceeded 60 deg. Cent.

It has been suggested to remove the water which was supposed to be chemically combined with the cellulose by steaming the threads, but this was a very tedious process. It has now been pointed out that the same gelatinous threads when well washed from the salts and from the acid may be exposed to hot air up to 140 deg. Cent. without becoming brown or producing an unevenness in dyeing afterwards, provided that care is taken that the air circulating at any place in the drying chamber maintains an equal velocity so that no warmer or cooler parts, caused by the evaporating water, exist in any section of the drying chamber.

It makes no difference if the temperature is not the same from one cross section to another, which may quite easily happen when the hot air becomes more and more saturated with water, and consequently cooled, but it is the usual practice to keep the air at the same temperature as when admitted by reheating it from time to time in its passage through the drying apparatus.

The escaping air at the end of the process is practically at the same temperature at which it entered and contains the maximum amount of water which is compatible for complete drying. It must be obvious to anyone knowing the great dissolving power of air, which becomes the more so with an increasing temperature, what a great economy of fuel must take place when less air at a higher temperature requires heating for a relatively short time in the drying process.

These improvements are of special significance for short fiber, which must be produced at a low cost on a very large scale if a constant market is to be created.—"Textile Mercury."

FINISHING TRICOTINES

Few dress--goods fabrics can equal tricotines in demanding the finisher's constant attention. With breaks, crow's feet, wrinkles, felted recesses and streaks, which the dyer is sure are caused by the finishers leaving soap or some other resist in the goods, while the finisher is just as sure that the streaks are caused by something the dyer has or has not done, the tricotine is a fabric which takes up a lot of time. The writer feels that a few words about the finishing of these goods may be helpful to some, although no guarantee can be given that every piece finished in the way suggested will be entirely free from all defects. Only extreme care and co-operation on the part of the dyer and the finisher can accomplish that.

Singeing and Crabbing

Tricotines are first carefully mended and then run through the singeing machine a sufficient number of times to have the back and face of the goods bare and entirely free from any loose fibers. The goods are then taken to the crabbing machine, where the water is brought to a boil and the pieces run through.

It is very important in this process that the goods be opened wide and freed from any wrinkles. Make sure that the bottom squeeze roll in each bowl of the crab is well padded with several thicknesses of fine soft cotton cloth. Two men should be at the front of the crab to guide the cloth in wide open and without any creases or wrinkles, because worsted goods take impressions very quickly while hot. The padding on the crab rolls must also be free from wrinkles or corrugations, leaving a perfectly smooth surface to the goods.

When the pieces are started off carefully, being crabbed in the grease, the danger of wrinkles and breaks is greatly decreased. If the scouring is done in a rotary washer let up on the springs on the top roll. The weight of these solid top rolls should be sufficient to ensure good scouring. If there is trouble with wrinkles, crow's feet and such defects, the washer rolls should be padded in the same way as the rolls of the crabbing machine, because with some stocks and yarns, breaks are so easily made that every precaution must be taken.

Make up an olive oil soap of 7 oz. to the gallon of water, with 3½ oz. of ammoniated potash. Now run the goods into the washing machine and cross one piece over the other, using the pot eyes. This will cleanse the goods thoroughly and at the same time will prevent the cloth from running in the same folds while in the washer. The goods will change their rope form every time they pass through the rolls. See that the speed of the washer is lively. Thirty minutes should be long enough to run in the soap.

Open the warm-water valve and let water in at about 115 deg. Fahr., not higher. Let the washer fill up, keeping it as full of water as can be used without having the pieces tangle up, so that the goods will be afloat and a quick and good job will be made of the rinsing.

I have removed a board from each side of the washer and 40 inches from the bottom. By keeping the lower gates always shut the soap floating on top of this 40-inch bath goes out first, and this also simplifies matters so that the operator has no need to be opening and shutting the lower gates during the process. The bath is the same depth all the time and prevents wrinkles that are often made from the goods packing down, fold on top of fold, with a shallow bath.

Be sure that every vestige of soap and alkali has been rinsed from the goods. Then open the cold-water valve for about fifteen minutes. Now take the goods from the washer, extract and send to the tacking machine, and from there to the dyehouse.

Wider than Finished Width

When goods have been dyed and again returned to the wet finishing room to be speck dyed, do this as soon as possible and then pass on to the extractor. After being well extracted the goods are run on the cloth dryer. Be sure to tenter the goods at least three inches wider than their real width.

When dried, the cloth should receive an inspection to see if it is level dyed and to note if any other imperfections may be found. Have any knots removed. Then give a light steam brushing followed by shearing.

After shearing pieces should receive a good pressing and a little steam should be blown on them from the back sponger as they leave the hot pressing cylinders. Goods should be allowed to cool off before final examination.

Removing Wrinkles

Now we will suppose that the goods on the first inspection were found to contain wrinkles and that these wrinkles were really felted marks in the cloth, an imperfection that often has its origin in the dyehouse. The simplest way I have found to get these out is to use a sand roll on the shear. It will polish off these felted wrinkles nicely. Then it is best to return the goods to the washer and run ten or fifteen minutes in warm water, just warm enough to be soft. This will eliminate the harsh feel. After a run on the shear and another pressing, pieces are again examined and if found satisfactory they are ready for the market.—"Textile World."

Turkey Red Discharge Styles

Turkey Red for Printing—Action of Chlorine and Caustic Soda—Discharge Colors—Free Lime—The Alkaline Process

By J. A. WILSON

ALTHOUGH this style has, in many cases, been substituted by para red, especially for domestic trade, still in the case of goods intended for the Levant, where fastness to light and washing is of extreme importance, it is quite impossible to supplant this article with para red.

The style is one of the most difficult and even after years of experience many troubles arise, requiring much thought and research to solve.

Plain Turkey Red for Printing

Goods intended to be dyed plain red for subsequent discharging must be well bleached, and in this connection the term bleached must not be meant to signify a mere white effect, but a thorough removal of all the impurities from the raw cotton and those introduced in the process of manufacture.

Too much emphasis cannot be laid on this important point. It is quite useless to try and avoid the teachings of experience in this respect. Any of the modern systems of keirs, coupled with the lime boil, will give satisfactory results, but as especially suitable may be mentioned the Mather & Platt system of the Theis keir.

The well-bleached goods are first padded in the usual manner in a solution of four gallons special Turkey red oil, 45 per cent; two gallons tournante oil emulsion; thirty-two gallons water.

The tournante oil emulsion is composed as follows: Eight gallons green olive oil, 25 per cent free fatty acids; twenty-eight gallons water; ten pounds pure sodium carbonate, free from iron. All traces of iron must be avoided in the materials used, as well as the vessels and machinery employed.

The oleine or Turkey red oil is made specially, and it is not a matter of indifference how it is manufactured, but it is not the object of this article to discuss the preparation of Turkey red oil.

The goods should be well dried, but not too hard, piled up twenty-four hours, and then steamed one-half hour at four pounds pressure, then padded in basic alum solution composed as follows: Thirty-six gallons of water, twenty-four pounds of Turkey red alum, two pounds pure sodium carbonate.

The pieces are allowed to stand another twenty-four hours and given a second aluming in the above solution, then dunged in chalk in the customary manner and are then ready for dyeing.

Action of Chlorine and Caustic Soda

This is perhaps the best place to make some observations on the subject of the action of chlorine and of caustic soda solutions on the various alizarine and allied compounds.

In order to produce the shade desired it is necessary to employ a mixture of blue shade alizarine or more or less of the yellow shade containing flavopurpurin and anthrapurpurin, although as a rule the shade required is mostly on the bluish side.

In the case of the chlorine process, it is not possible to notice any marked difference in the behavior of goods dyed with, say, quantities of anthrapurpurin. The white and colored effects seem to be about the same as with the use of all-blue shade alizarine; if anything, the blue shade of Turkey red is a little easier to discharge.

On the contrary, with the alkaline method, it is my experience, as well as others, that flavopurpurin and anthrapurpurin are easier to discharge by the alkaline method than is alizarine for blue; therefore, it is as well to keep on the yellow side as much as possible, in case one is not compelled to work absolutely to shade.

In view of the fact that strong alkaline solutions are used in the subsequent clearing in this style, it is customary to use a slightly different oil preparation for the alkaline process. In place of the oil preparation mentioned above use, therefore, six gallons special Turkey red oil as above, two gallons tournante oil emulsion, two pounds stannate of soda, thirty-two gallons of water. The aluming and subsequent steaming is the same as with the chlorine discharge process, as is also the fixing in chalk.

As to the dyeing in alizarine, this does not call for any special mention. After dyeing the pieces, pass to the clearing operation, which is absolutely necessary in order that perfect whites and colors shall be obtained. The pieces are given a keir boil overnight in 1,200 gallons of water 120 pounds of soap and two quarts of oxymuriate of tin.

This quantity is enough for 500 pieces of usual weight for this style of goods. The pieces are boiled about eight hours, then washed and reboiled in two pounds of stannate of soda, two pounds tin crystals, eight pounds white soap, four gallons Turkey red oil and thirty-six gallons water. After padding in above solution, steaming at four pounds pressure, the pieces are soaped off, washed and are ready for printing.

An alternative process involving the use of aluminate of soda can be used for the caustic discharge style with advantage. In place of the above-mentioned preparation prior to aluming, use six gallons of aluminate of soda, 16 Tw., free of iron; four gallons Turkey red oil as above, two pounds tin crystals, two pints of ammonia, thirty-six gallons of water. The subsequent operations are as above mentioned. The red produced on this mordant is easier to discharge by the caustic method than the one without the addition of aluminate of soda.

Discharge Colors

The discharge colors, chlorine style:

White—Sixteen gallons thickening, four gallons lemon juice—sixty-four ounces per gallon in terms of citric acid; forty-eight pounds citric or tartaric acid, one pint Prussian blue paste.

Blue—Four gallons white discharge, one gallon Prussian blue pulp.

Yellow—Sixteen gallons water, sixteen gallons lemon juice, eighty-six pounds lead nitrate, forty pounds tartaric acid, forty pounds thickening.

Green—Six parts lead yellow discharge as above, one part Prussian blue paste.

Black—Vanadium aniline black.

The lemon juice can be substituted with lactic acid, and in cases where permissible, a certain proportion of arsenic acid can be used to cheapen the mixture.

The pieces are printed in the usual manner and aged to develop the black, and are then ready to pass to the bleach vat for cutting. This is done on the open soaping machine. The first two vats of the range are about two-thirds filled with a solution of bleaching powder and, in addition, four ounces per gallon of lime previously well slaked; the addition of lime is obviously to take up the acid coming from the goods.

The bleaching powder solution used must contain about 2½ per cent of available chlorine all the time, and must be freshened up with strong solution of chlor in order to maintain this proportion of chlorine; the vats must be constantly tested every twenty minutes, and for this purpose there is nothing better and more convenient than the nitrometer. With this instrument an accurate test can be made in less than five minutes.

Free Lime

The proportion of free lime can be estimated in the same test by adding a little more hydrogen peroxide, then an excess of standard hydrochloric acid, finally titrating back with standard alkali.

This testing is so simple that it can be carried out by the foreman in charge of the operation. The temperature must be kept around 125 deg. Fahr. The pieces then pass through three becks of cold water and finally the yellow, blue and green are raised. The pieces after leaving the washing becks pass through a bichromate solution

at a temperature of 165 deg. Fahr., 160 gallons of water, eighteen pounds bichromate of soda and 200 pounds common salt. Then follows a passage in hot and cold water. Finally the pieces are dried on the cans and finished.

In cutting a large number of pieces the success of the operation depends largely on the maintaining of the bleach bath at a constant strength and the prevention of decomposition due to the acid coming from the goods.

The Alkaline Process

This method is used mostly for the black, yellow and white effects on Turkey red ground, especially black and yellow. As mentioned above, the cotton goods are prepared and also dyed a little differently for this process, although the regular red can be used in case it is a question of using goods out of stock.

Black—Vanadium aniline black as above.

Discharge Yellow—Dissolve forty pounds commercial lead nitrate in six gallons of water; cool and add, keeping the mixture as cool as possible, fifty-two pounds caustic soda in water, finally make up this mixture to measure ten gallons with thick gum solution.

Discharge White—Eight gallons gum water, eight gallons caustic soda, 64 deg. Tw., one quart crude glycerine, two quarts tin oxide paste.

These discharges are worked warm in the machine and the printed goods dried fairly hard are allowed to age overnight, passed through the Mather & Platt and taken direct to the open soaper.

In this machine the goods are given three becks of silicate of soda at the boil. The bath is composed of 180 gallons water and six gallons silicate of soda. After leaving this vat the pieces receive a weak bleach bath in case white is present in the pattern; otherwise the pieces are raised in chrome as above described without the bleach bath.

For this work it is customary to employ indigo for the blue and a mixture of indigo and lead yellow for green.

Discharge Blue—Eight gallons British gum thickening, eight gallons caustic soda, 64 deg. Tw., four gallons indigo paste.

Discharge Green—Six gallons discharge yellow, four gallons discharge blue as above.

The goods are padded slightly warm with a solution of glucose made as follows: Thirty gallons water, fifty pounds commercial glucose. In padding, some considerable pressure must be used in order to impregnate the goods thoroughly; inasmuch as oiled pieces are not easily penetrated, the goods are then treated as above described.

Many efforts have been made to apply direct colors as also chrome coloring matters in this style, but the results have not been satisfactory.—"Fiber and Fabric."

The True Alizarine Dyes on Silk

Alizarine with Aluminum—With Chromium—With Iron—The Dye Bath—Dyeing Pale Shades—Brilliant Alizarine Blue G and R—Alizarine Black

By GEORGE EMMONS

THE true alizarine dyes are fast derivatives of dioxyanthraquinone—that is, of alizarine itself. The empirical chemical formula may be written $C_{14}H_8O_4$ or $C_{14}H_5O_2(OH)_2$. The true alizarine dyestuffs belong to the larger class of mordant dyes. They produce on silk shades that possess a comparatively high degree of fastness to light, boiling, soap and washing. It may be that acid and basic dyes may be applied to silk at less expense and produce purer and more brilliant shades. At the same time, a good deal of silk dyeing would be very advantageously done if the fastness mentioned could be confidently expected. The true alizarine colors are to be commended where these qualities are highly desirable and where a reasonable advance in costs is permissible.

Alizarine is a polygenetic color, that is, the shade varies with the mordant used.

Chromium gives clarets, maroons.
Iron gives violets.
Tin gives oranges.
Copper gives dull violets.

Silk is dyed with alizarine and any one of three mordants—aluminium, chromium or iron. The mordant will naturally be in the form of some salt. More or less of the mordant will be deposited on the silk fiber, where it may be expected to bring about the loss of a certain amount of luster and of pliability.

First, the silk is discharged, washed and wrung. It is then ready for the mordanting operation.

Alizarine with Aluminium

Where aluminium is to be the mordant, one must expect some loss of luster and pliability. It may or may not be possible to correct these losses to some extent. The mordanting is to be done at a low temperature—say, at about the temperature of the surroundings. This precaution tends to prevent loss of gloss and feel. In consequence of this low temperature requirement, the aluminium salt must be one that easily dissociates. It is said that alum has not yet been replaced by aluminium sulphate as an aluminium mordant probably because alum that is slightly basic decomposes more easily than basic

aluminium sulphate. Prepare the required basic-alum mordanting bath with:

Alum	10 parts
Soda crystals	1 part
Water	about 150 parts

The amount of water may vary somewhat. The thing desired is plenty of water for complete solution. When the ingredients have been mixed the whole is heated gently until the precipitate first formed has vanished. One may add tin crystals, if desired. The amount relative to alum is 0.4 per cent of the weight of the alum. Instead of basic alum, one may substitute aluminium sulphate-acetate or aluminium nitrate-acetate, and prepare the bath along the same general lines.

The silk is now wetted out thoroughly, after which it is wrung evenly. It is then put into the mordanting bath, where it is worked for a time, but without heat. Next the fiber is permitted to soak where it is for, say, twelve hours. It may now be wrung and then washed in water, but it is considered preferable first to fix the aluminium by passing the fiber through a solution of silicate of soda. This bath will have a density of 1 deg. Tw. Or, one may substitute a soap bath for the one containing the silicate of soda. Finally, the fiber is well washed in water, to get rid of all traces of the mordant and of the fixing agent. The silk is to be withheld from drying once it has been mordanted, since wetting out a second time is more or less difficult and the feel is apt to be made unpleasant.

While the twelve-hour steeping is in progress, the fiber will absorb more or less basic sulphates or basic sulphate-acetates or basic nitrate-acetates. Then, later on, the treatment with water or silicate of soda or soap operates to decompose the basic salts and facilitates the deposition of aluminium hydroxide in the fiber. Since the solutions have all been cold, we get a gelatinous hydroxide and this substance is understood to be less likely to affect the silk injuriously than if a more crystalline hydrate had been formed. This hydrate requires a higher temperature for its formation.

The baths indicated above may be used continuously, provided they are properly freshened up each time they are to be employed in service.

An alternative to the foregoing methods of mordanting with alum may be followed. Thus, the following recipe may be used:

Alum	10 parts
Sodium thiosulphate	4 parts
Water	100 parts

The alum and the thiosulphate are dissolved in the water. The silk is then given a three-hour treatment in the bath, the temperature being pushed up gradually from hour to hour. During the first hour, it is to be raised to 140 deg. Fahr., during the second to 140 deg. Fahr., and during the third to 176 deg. Fahr. The fiber is then withdrawn and rinsed. Afterwards it is dyed.

Alizarine with Chromium

Where it is desired to use chromium, one may use chromium chloride or chrome alum. In case chromium chloride is to be used, the liquor is given a strength of 32 deg. Tw., and the silk is simply steeped in it for twelve hours, the bath being cold. Or, if chrome alum is to be used, then a cold bath having a strength of 9 deg. Tw. is employed, and the fiber is steeped for twelve hours. After the twelve-hour steeping treatment is over—whether chromium chloride or chrome alum is used—the silk is wrung out and thoroughly washed. A bath will, in the meantime, have been prepared with plain, cold water and sodium silicate. This bath is given a strength of ¾ deg. Tw. After thorough washing, the silk is put into this bath and there worked for thirty minutes. The result of either of the two procedures is to secure a precipitation of one or more basic chromium salts on the fiber.

In general, neither bichromate of potassium nor bichromate of sodium is to be used in mordanting silk fiber.

Chromium chromate, $Cr_2(CrO_4)_3$ has been recommended for use with the dyeing of silk. The following recipe may be used:

Chromium chromate	1 part
Water	4 parts

The chromium chromate is simply dissolved with the water. The cold liquor is then ready for use. The silk fiber is steeped for twelve hours and then washed in plain water, when it will be ready for the dyeing operation.

All the foregoing methods of mordanting are to be regarded as applicable preparatory to dyeing with alizarine. However, before using these directions, or any other, the dyer will generally do well to try out the recipe in a small way before committing himself on a large scale. He may find some minor variation of value, because of some peculiarity in the water or the character of the chemicals employed.

Alizarine with Iron

We come now to "nitrate of iron." This is a silk mordant, but it contains no nitrate of iron. In fact, it contains neither ferric nitrate nor ferrous nitrate. All the same, dyers call the substance "nitrate of iron." This liquor may be prepared by heating up a solution of ferrous sulphate (coppers, green vitriol) with nitric acid and sulphuric acid. It is said to consist of ferric sulphate, basic ferric sulphates and ferric sulphate-nitrates. The ferric sulphate is the chief constituent. Most of the commercial preparations were found by one investigator to be quite suitable for silk. Naturally, in a complex thing like "nitrate of iron," the purchaser is apt now to get one thing, now another. The best policy is to make it up or

have it especially prepared. The following will serve perhaps as a guide:

Ferrous sulphate	72 parts
Sulphuric acid	6.3 parts
Nitric acid (67 deg. Tw.)	12.6 parts

When properly prepared, the product is represented by the formula $Fe_4(SO_4)_5(OH)_2$. This is basic "nitrate of iron."

The solution is prepared for mordanting and the silk is then steeped for twelve hours. Then it is wrung out, washed, and soaped in a boiling solution of soap. After this treatment, the silk is ready for dyeing with alizarine or one of the true derivatives of alizarine.

The foregoing methods of mordanting are to be regarded as having application to all dyes belonging strictly to the alizarine series. Further, they are to be regarded as usable with the coal-tar colors generally that are applied with the aid of mordants. The dyeing methods are also to be viewed as applicable to the true alizarine dyestuffs and to the mordant colors in general. The dyer should always try out a method on a small scale.

The Dye Bath

The dye bath may advantageously be made up as follows:

Plain water	80%
Boiled-off liquor	20%

The total weight of the bath may be about twenty-five times the weight of the silk. Thus for 100 pounds of silk, 2,500 pounds of bath are to be supplied:

Plain water	200 gallons
Boiled-off liquor	50 gallons

The boiled-off liquor should be free from soda. There can be too much gum left from the boiling-off operation. Acetic acid may be employed to give the bath its proper condition, if it should be found alkaline. If an aluminium mordant is to be employed, enough acid is added to neutralize the bath; but if a chromium mordant, to acidify it slightly. The bath may be used continuously. However, before putting in the acid, the color solution is put in. Then as soon as the acid treatment has been given the bath, the silk is entered, the bath being cold.

The fiber is now worked for, say, fifteen minutes. For forty-five minutes, the bath is heated up to the boiling point and then kept at the boil for one hour. A washing in plain water is now given, whereupon a boiling in a soap solution follows. This soap solution is made by adding 0.2 per cent of soap to plain water. This percentage is based on the weight of the water. The amount may readily be calculated, if one remembers that one British imperial gallon weighs ten pounds. The colors are made more brilliant by prolonging and strong soaping. The brightening is done in dilute acetic acid. This acid bath may be made by adding 2½ per cent of the weight of the water in acetic acid. The water is to be tepid. The work when removed is to be dried without washing.

Dyeing Pale Shades

If a pale shade is desired, one of the following recipes is to be used:

Alum	3%
Oxalic acid	2%
Or, Chromium acetate (32 deg. Tw.)	3%

Either recipe is used with a proper amount of plain water. The dyestuff is made into a paste by adding it to ten times its weight of water and stirring the whole. The paste is then passed into the bath through a fine sieve.

With the bath at 30 deg. Cent. the silk is entered and turned or worked for, say, a quarter of an hour. The whole is next brought to the boiling point in the course of about forty minutes. The boiling is continued for one hour. Afterwards, the silk is rinsed. It is then given the soap treatment mentioned above and then the acid treatment.

A high authority may be quoted here in respect to the matter of fastness. "On silk, the mordant colors are, as a rule, very fast to light, soap, or milling, if properly dyed. The affinity of the silk fiber, however, for the metallic mordants, especially for chromic oxide, is less distinct than that of wool; and the colors are not always fixed quite so fast on silk as on wool. Still, the colors are much faster on silk than the acid or basic aniline colors, and deserve the attention of silk dyers." Another says, "The fastness of the shades obtained by this method varies with mordant dyestuffs other than the true alizarine series. Preliminary tests should always be made of such a dyestuff before it is dyed on the large scale." Still another authority, "There are, of course, occasions where it is desirable to dye colors on silk which shall have preeminent fastness to light and sometimes to washing, and in such cases it may be necessary to employ the mordant dyes."

Alizarine Black

Alizarine Black is suited to dye silk. An iron mordant may be employed. The silk is first worked for two hours in a bath consisting of plain water and stannic chloride, the liquor having a strength corresponding to 52 deg. Tw. After this treatment the silk is wrung and then well rinsed. It is then given a soap treatment for two hours in a bath at 35 deg. Cent. The bath contains, besides plain water, 5 per cent of the weight of the silk in soap, and 60 per cent in soda crystals. After this soaping the silk is worked for thirty minutes in a solution of "nitrate of iron" of 52 deg. Tw.

Next, the silk is rinsed. Then it is treated in a soap

bath for 1½ hours at 75 deg. Cent. The soap is to be a neutral one, and the amount of it 10 per cent of the weight of the silk in the yellow prussiate of potash and 10 per cent in hydrochloric acid.

This method produces ultimately a blue tone. Next, steep the silk in a liquor which is just about to boil. This is to be kept up for two hours. This liquor is made by adding to plain water half the weight of the silk in catechu. A rinsing is then given. The dyeing may be done in a bath containing 30 per cent of the weight of the silk in Alizarine Black WR. The dye liquor is to contain, in addition, 5 per cent of neutral soap and a little acetic acid. The silk is entered with the bath cold. In the course of one hour the temperature is brought up to the boiling point. This condition is then maintained for 1½ hours. If less weighting is desired, the treatment with stannic chloride followed by a soaping may be omitted.

Brilliant Alizarine Blue G and R

These mordant colors are similer to another which is termed Indochromine T. Brilliant Alizarine Blue may be used along with a chrome mordant to dye silk shades of blue which are quite pure and are understood to be very fast to light, soap, water, acids and alkalis. If there is a good deal of calcium carbonate in the water, it may be boiled with sodium sulphate.—"Silk."

The Finishing of Fine Worsteds and Woolens

Palm Oil vs. Tallow Soap—Alkali—Scouring of the Fancy Woolens—Drying and Tentering—Cutting—Abolition of Steam for Blowing—Hydraulic Pressing—Potting and Raising

By A. JACKMAN

A Paper Presented Before the West Riding Section of the Society of Dyers and Colourists, and Printed in the Journal of the Society

THE first process in finishing a fine fancy worsted is scouring, and the machine used is the ordinary "Dolly." For efficient scouring, soft water, neutral soap and alkali are essential requirements. Wherever hard water is used the lime and magnesia soaps formed result in a waste of scouring material, trouble with dirty pieces which rub badly and develop a smell, and unsatisfactory dyeing.

Bradford and Huddersfield Corporations supply water varying from 2 to 6 deg. of hardness. With 6 deg. of hardness good results may be secured with care, but there is a loss of soap and alkali; however, the water is seldom above 4 deg. in Bradford, and usually under this in Huddersfield. Water treated by the Permutit plant is reduced to absolute softness. In scouring with this water there is a distinct saving in scouring material, but not such as to justify the installation of a softening plant where these corporations' waters are obtainable.

Palm Oil vs. Tallow Soap

Until recently it was supposed that a soap with a high melting point was best for milling, and many used tallow soap for both scouring and milling. This theory has been exploded, and as tallow soap has certain disadvantages it is falling out of favor. There is more trouble in the dyehouse through traces of soap being left in the pieces than from any other fault. Palm oil soap is quite as good for scouring as tallow soap. It costs less to boil up and keep fit for scouring, and will work satisfactorily at a lower temperature; also it washes out of the pieces more easily, and there is thus less liability to dyeing faults when this soap is used. When potash soap could be bought cheaply it was most popular among finishers and dyers, as it washes out of the pieces most freely. The relative value of these various soaps has been much discussed. Exhaustive tests extending over months have shown no difference between pieces scoured with potash soaps and palm oil soaps. With either soap excellent results in handle and appearance can be secured. Pieces scoured with tallow soap may feel harder than those scoured with potash or palm oil soaps, this being due to a slight milling during the extra time required in washing off, or to soap being left in the pieces.

Alkali in Scouring

In scouring worsteds and woolens the alkali should be about 6 deg. Tw. Taking, as example, the scouring of four pieces fancy worsteds weighing about 250 pounds, the pieces are threaded into the machine and wetted out in water not above 100 deg. Fahr. A few gallons of alkali and a little soap are added, and after running a while the dirty liquor is run off. Then

more alkali and some soap are added, and the solution gradually works up into a good lather. After running a few minutes more, alkali and soap are added if necessary and the pieces are run until clean. Dirty pieces are slippery when gripped in the hand, but when clean they scroop like silk. The goods are finally washed off in warm water until the solution lathers up white, and then finished off with 2 gallons of soap, when the lather should come up like whipped cream. The make of the pieces will determine the length of time the goods should be run in this bath. Soft pieces should be washed off as soon as the lather comes up satisfactorily, but hard close makes will benefit by being run for some time. In washing off, the water should be at or below 100 deg. Fahr. If too hot, both handle and appearance of the pieces are affected.

When the pieces are for dyeing, the final washings should be very thoroughly done, and every possible trace of soap removed. It is impossible to get good dyeing results if scouring is not efficiently performed, and the dyer should be put in charge of and made responsible for the scouring of all pieces for dyeing.

Scouring of Fine Fancy Woolens

The scouring of fine fancy woolens is a rather different process from fine worsted scouring. In these woolen pieces there is sufficient oil to form with the alkali a good scouring agent, and the lather will not fall as quickly as when scouring worsteds; in fact, if too much alkali is used the solution will work up to the top of the box and the pieces will slip between the rollers. Worsteds may be scoured clean with alkali only, but scouring is not simply a cleansing process, it is a cloth-working process, and the scourer should have in mind the appearance and handle of a cloth, and the best results are certainly secured by the use of soap and alkali. Woolens certainly can be scoured clean with alkali; but even woolens are benefited by the addition of soap.

Drying and Tentering

After scouring, fine fancy pieces should be hydro-extracted as dry as possible and tentered at as low a temperature as possible. The ideal tentering would be done in the open air, but as this is impossible the conditions should approximate as closely to the ideal as circumstances permit. The handle and color of many goods suffer as a result of unskillful tentering. To get too much length out of pieces in the tentering machine is a mistake; a piece should be stretched sufficiently in width and length to bring the warp and weft, disturbed in scouring, into order, and no more. If a piece is carefully examined after scouring it will be found that the threads are inclined to curl, especially the tightly twisted threads. Sometimes it may be necessary to crab the pieces before tentering to eradicate this evil, but generally fine fancy pieces should be tentered as soon as possible after scouring.

Dyed goods benefit by crabbing, but in this process the temperature of the water should be fixed after consultation between dyer and finisher.

Cutting a Fine Art

If the pieces are for clear finish they are brushed and cut after tentering. Brushing is a very simple operation, but cutting is a fine art, and the correct setting of the cutting parts calls for much skill. In a well-ordered mending-room all loose ends and knots are pushed through to the back of a piece and the face is left absolutely clear. Unfortunately, the finisher cannot depend upon this always being done and he is forced to adopt methods to overcome the dangers which beset him through careless and unskilled mending and knotting. If a finisher was able to pass on to the mender all manufacturer's claims for knot-holes cut in pieces it would insure a rapid improvement in the quality of the work turned out in the mending and knotting department. A hollow-bed machine enables a finished to avoid knot-holes, but at the same time he cannot crop a piece clear on this type of bed. A more efficient crop which avoids knot-holes is obtained by using the rubber Martin's bed. In this the hollow bed is cut in half and a length of rubber tube is fitted into the lot. Another type is the fender or spring bed. This crops clearly but gives little latitude for poor mending or knotting. A solid bed, once set truly, is always true, but it is merciless. However, if a layer of felt is placed over the bed and covered by and held in position with a glazed linen cloth, this bed may be used with the same confidence as a rubber bed. The expert cutter studies the quality and setting of the cloths and treats them accordingly. The handle of a firm, closely set cloth may be spoiled by being cut too keenly, while, on the other hand, a loosely made cloth would be too dull and muddy if similarly treated and after a few months' wear would look like a milled cloth. In this process the human factor counts for a great deal. A successful cutter needs a fine eye and a delicate touch and an enthusiasm for his work.

Blowing by Air and Vacuum Pump

The process of blowing has undergone many changes in recent years. At one time all blowing was done on the steam kettle. The pieces were wound tightly onto a perforated roller and then placed vertically on the kettle. Steam was blown through and then the pieces were left to cool a few hours before being taken off the rollers. Now machines are used in which the pieces, after steaming, are cooled by means of air drawn through by a vacuum pump. The softer cloths are improved by this process, for without losing their suppleness they are made to feel firmer. The draping

qualities of all cloths are improved as a result of blowing. In this process damp wrappers must be guarded against, the tension of the piece and the wrapper must be equal, and creases in paper and wrapper avoided. If water gets on the piece the colors may run; if the tension is unequal the piece may be water-marked, and if the piece or wrapper is creased or uneven in blowing the piece will probably have to be wetted out and retentered before the creases man be removed. This process gives some luster and partially shrinks a piece, and a blown piece retains its condition much longer than when pressing is solely depended on for the getting up of the cloth.

Hydraulic Pressing

In pressing, at one time, all pieces were papered by hand and then put into the hydraulic presses. When the rotary press was put on the market it was expected that the old, slow method would soon be superseded. The jumbo press followed; but though the work of rotary or jumbo presses may be considered good enough for certain goods, they are of no use whatever in the fine trade. These machines reduce the cost of labor and accelerate output, but there is no comparison between the results of hydraulic pressing and machine work. Where heat and weight are judiciously applied, hand papering and hydraulic pressing give a splendid and desirable finish to all the preceding processes.

Potting and Raising

Potting and raising do much to perfect the finish of faced cloths, such as broadcloth, beaver and billiard cloth. Prior to the introduction of velours the teazle gig was going out of use, but this old-fashioned machine is indispensable for that type of cloth. Finally, it is a mistake to hurry pieces through the finishing department if the best results are desired. A piece unduly stretched will never give the desired handle; and for the sake of a few pence it is folly to imperfectly finish a piece upon which time and thought have been spent to produce a perfect cloth beautifully designed. We are up against keen competition; we need not only to make a good cloth but to give it a finish worthy of the product.

Discussion

In the discussion of this paper, the chairman (H. Jennings) said that a manufacturer would do well to get his scourer and his dyer and finisher to work together, because there was no doubt that the one could spoil the good work of the other. Many of the sizes and weavers' dressings which were used were complicated in composition, and sometimes caused latent faults which subsequently developed in the scouring or dyeing and finishing processes.

Dr. S. A. Shorter asked for the lecturer's opinion on the value of a soda oleine soap. In connection with the strength of alkali, Mr. Jackman mentioned 6 deg. Tw., but if that was the strength of the stock solution, in actual practice, with the water already present, the strength would be very much less—perhaps 3 or 4 deg. Tw. He was in complete agreement with the lecturer in recommending the use of alkali in small concentrations at the outset. If too strong alkali were used there was a tendency to salt out the soap.

With regard to blowing and crabbing, theoretically blowing with steam and crabbing with boiling water were equivalent. Did Mr. Jackman regard the two processes as being so? The question arose as to what temperature was the best to secure the desired result. The fiber was a gelatinous structure which was in a state of strain, the strains being highly irregular. So long as the piece was dry those strains were latent, but directly the piece was wetted the strains became effective and gave rise to trouble. The object of blowing and crabbing was to eliminate these elastic strains as completely as possible. For that purpose was the temperature of boiling water the best? Such a temperature had no special significance, and he would like to know what temperature was necessary for this setting process. It might conceivably be a lower temperature than boiling point; on the other hand, in some cases a higher temperature might be required to obliterate the strains. From other points of view, the treatment with boiling water or steam was undesirable, and was only done in order to avoid greater evils. With regard to pressing, pressing with rollers was a much gentler process and had a more transient effect than the ordinary pressing process. Theoretically it should be done in the presence of water and at a high temperature to get the maximum effect. In practice what was the condition of the piece as regards moisture when it went to the press, and how much water did it lose in the process?

The lecturer said that oleine soaps were very successful. With regard to the strength of alkali, the stock solution was 6 deg. Tw., but on the piece itself the strength might not be more than 2 deg. Tw., particularly on whites, and it might get down so low as 1 deg. Tw. Milling without the addition of either soap or acid was adopted for certain special cloths. Dr. Shorter had said that theoretically blowing and crabbing at the boil were equivalent, but in practice they were not. Fancy colored pieces could be blown with dry steam, but could not be crabbed at the boil. A cloth bleached with sulphur would be turned yellow by blowing, but generally speaking the ordinary acid colors changed very little in dry blowing. He did not think that blowing would set a piece as effectively as crabbing at the boil. With regard to the condition of the pieces in the press, practice varied greatly. Some finishers damped their pieces heavily and some lightly before putting them into the press, and others not at all. If the pieces were damped they lost weight in pressing, the percentage loss depending partly

upon the condition of the papers. If the papers had been used for absolutely dry pieces, there would be a loss of 6 to 8 per cent. Where pieces were being pressed continually in the damp, the loss would probably be 4 per cent.

Crabbing at the boil was a necessary nuisance. It was a great pity that the wool fiber had to be put in boiling water at any time, because it had a deleterious effect.

D. T. McLellan said that in the Bradford district light goods were crabbed at the boil before dyeing to set the piece, which would otherwise cockle in the boiling dye liquor. The standard tallow soap contained cocoanut oil, as pure tallow soap was rather difficult to lather. It was not possible to wash out all the soap from pieces; there was generally 0.1 to 0.2 per cent left in, and that was why it was so dangerous to use inferior soaps.

The lecturer said that with regard to tallow soap there was some difficulty in getting a satisfactory lather if used in too concentrated a form. Personally he preferred palm oil soap, but would use potash soap exclusively for milling as well as for scouring if it could be bought at a reasonable price. With regard to washing out the soap, he quite agreed it was impossible to get rid of it completely, but as much as possible ought to be removed. It was useful to use a pint of ammonia during the washing-off process, which lathered up any residual soap.

F. Wilson asked what temperature Mr. Jackman regarded as the best in crabbing fine white worsted pieces, and in reply the lecturer said he would not crab a fine worsted at all, unless it were a very thin cloth.

Prof. Eber Midgley said that whether a piece was crabbed or not, and if crabbed the degree of treatment depended on the type and quality of raw material, the structure of the thread in the cloth, and the build of the fabric. In each of those factors there were so many incidental factors that it seemed impossible to arrive at any standardization. Worsted cloths, well set, made from uniform yarn and high quality wool, need not be crabbed, because the fibers were uniform in length and diameter. The higher the quality number, the more uniform was the material. On the other hand, when lower qualities of wools, such as crossbreds, were employed in the manufacture of worsteds, there was a great variation in diameter and in length and a corresponding variation in fiber movement, and consequently those goods must be crabbed. Crabbing by means of a perforated metal cylinder, crabbing with a single crab or on a double crabbing machine, and blowing with steam or boiling the piece were matters of degree. His own views with regard to the theory of crabbing were that if the fabric were composed of fibers which varied a good deal in diameter and length, that fabric would be a mass of unbalanced strains, because the strains would vary according to the dimensions of the individual fibers. The fiber was a horny substance, and under the influence of moisture at high temperatures it became plastic and could be forced into a new shape. If it were held in that shape until it became cold, that new shape would be permanent. In a piece rolled on a perforated metal cylinder, the wool fiber was under control, and was subjected to moisture at high temperature provided by means of water or steam, and to the pressure of one fold of cloth on another, augmented by the wool pressure due to the fibers swelling. If the fibers were forced to remain in that constrained position until they cooled down, they would be firmly set. More or less the same thing applied to pressing. In pressing one wished to give the cloth the required feel and appearance, in addition to leveling the surface of the fabric. Moisture, high pressure, and cold pressing each had its own effect. As the lecturer had repeatedly said in his paper, cloths must be treated according to the type and quality of the raw material, and the properties of the fiber had to be preserved if the resultant fabric was to be of the highest value.

G. E. Griffiths asked the cause of the occasional watermarking which appeared after dyeing crossbred serges.

The lecturer said that pieces sometimes became watermarked in crabbing. The pressure of the back on the face when the pieces were crabbed without an intervening wrapper would cause it. In some cases the pieces were wound too tightly, and in some cases the pressure was uneven. Watermarking could also be produced in dry blowing. Sometimes the blower might get his wrapper tighter than the piece, or *vice versa,* and if the cloth was fairly solid a watermark would result. A watermark could not be obtained in dyeing, but in crabbing one had to fight against it all the time. Pieces could be watermarked by an uneven pressure.

CHINA'S 1921 DYE IMPORTS

The trade in aniline dyes and artificial indigo during 1921 was influenced by falling exchange, heavy stocks, and weak markets. The outstanding feature of the year was the drastic and continuous fall in market prices. Throughout the whole period of the war and for a considerable time after the Armistice the supply of dyestuffs in China did not meet the demand. This, coupled with the then favorable exchange, resulted in selling prices remunerative alike to the foreign importers and Chinese dealers. The situation was completely reversed during 1921, when a falling off in the demand and the re-entry of Germany as a factor into the world's markets resulted in keen competition for the China trade and a sensational drop in prices, which at the close of 1921 were not more than half of the prices ruling in the previous year. In spite of these unfavorable circumstances, the importation of aniline dyes in 1921 rose from 7.7 million to 8 million taels, while artificial indigo shows a slight decrease in value, from 15.3 million to 15.2 million taels, as compared with the preceding year. Of the indigo imported, 3,535,600 taels worth arrived from France, and 2,617,177 taels worth came from the United States. Of the remainder, 1,934,448 taels is credited to Great Britain, 1,857,124 taels to Germany, and 1,289,373 taels to Switzerland. As regards aniline dyes, the principal countries of origin of the amounts imported into China in 1921 were: Germany, 3,390,278 taels; Hong Kong, 1,398,186 taels.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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AN INVITATION TO A. A. T. C. C. MEMBERS

DURING the week of the Eighth National Exposition of Chemical Industries, to be held September 11-16, inclusive, at the Grand Central Palace, New York, the AMERICAN DYESTUFF REPORTER will occupy Booth No. 743 and maintain therein a visiting headquarters for members of the American Association of Textile Chemists and Colorists.

It is our aim to make this booth a real convenience for all members of the organization, and to this end there will be provided a register in which visiting chemists can place their temporary addresses, telephone numbers, etc., and thus facilitate communication and the making of appointments. All members of the Association should not fail to place themselves on record as early in the week as possible, and in addition should feel free to make this booth their headquarters throughout the run of the Exposition.

The booth is intended expressly for the service and convenience of our friends, all of whom will be made welcome at any time. Those in charge will be glad to take messages, look after personal property, and in every way carry out the wishes of visitors. You are cordially invited to take full advantage of whatever facilities we may be able to offer.

THE SENATE DYE DECISION

WHILE nothing definite will be known, of course, until after the joint conference of the House and Senate on the Fordney-McCumber tariff bill, and all comment must therefore be of a rather speculative nature; nevertheless, judging solely from what can be gleaned here and there, the American dye industry appears at this writing to be hopeful of seeing a successful termination to its nearly four years of struggle to obtain adequate protection from foreign competition.

On Thursday, August 17, the Senate, sitting as a committee of the whole, voted 38 to 23 to adopt the amendment of Senator Bursum, of New Mexico. And by virtue of this amendment the duties on imported coal-tar intermediates are to be increased from 50 per cent ad valorem and 7 cents per pound on the foreign valuation to 75 per cent ad valorem and 10½ cents per pound on the American valuation, and the duties on finished coal-tar dyes and chemicals are to be raised from 60 per cent and 7 cents per pound, foreign valuation, to 90 per cent and 10½ cents per pound, American valuation.

On Friday, the day following, the Senate approved by a vote of 39 to 31 its action of Thursday, while on Saturday it officially passed the bill in its entirety, thereby making further changes impossible unless made in conference.

Senator Smoot vigorously opposed these duties, which it is agreed amount virtually to an embargo. He succeeded on Saturday in gaining Senatorial approval of an amendment which empowers the President, after the bill shall have become a law, to change duties on dyestuffs within fifteen days after his proclamation to that effect, whereas in all other cases sixty days must elapse before changed rates can become effective. And since the Bursum amendments provides that the President cannot increase the rates on dyes, no other change but reductions can be made. Senator Frelinghuysen, however, whose embargo amendment was not put to a vote in view of the success of his colleague's, declared that he was satisfied that the President, whose sentiments with respect to protection for the dye industry have already been expressed and chronicled in these columns, will not care to lower any dye rates aften an investigation of the facts surrounding the industry.

The Bursum amendment also provides that where there is no comparable competitive American product to use as a basis for fixing American valuation, the foreign price, or the export price, whichever happens to be higher, shall be used by the Customs officials, and it specifically states that products shall be considered comparable when they accomplish substantially the same results—a most important ruling.

Since it is believed that the dye section of the tariff bill may be reached by the conferees at an early date, the final decision may be a matter of history by the time this appears in print. It is not thought that there will be a great deal of difficulty over the matter of rates, particularly the rates applied to dyestuffs by the Senate. But the principal struggle is likely to center around the question of American *vs.* foreign valuation, on which subject the House and Senate are diametrically opposed. One side or the other must give way in this, or the bill will be dead so far as this session of Congress is concerned. Should an agreement be reached, however, the tariff may be a law as early as October 1. Senator Fordney is known to be strong-

ly in favor of the American valuation program, and opponents of it are outnumbered among the Senate conferees. This phase of the measure is particularly vital to the dye industry, in which German efficiency and manufacturing methods have been brought to such a high degree of perfection that competition on a foreign valuation basis, even with duties at 90 per cent, would be extremely difficult.

In the event that the dye section of the bill is allowed to remain substantially as the Senate drew it up, then the American dye industry can safely be said to have gained truly adequate protection at last. Moreover, it will be a protection of infinitely greater value than the protection which it has "enjoyed" during the past four years, for the reason that it is likely to remain in force as long as the Republicans retain their power. It is distinctly a Republican measure, the product of campaign pledges and an abiding belief that many of our industries, particularly the war-born ones, were not receiving protection sufficient to permit of their existence in the face of present European conditions. And in the case of a vital necessity such as the coal-tar chemical industries, such protection was indispensable.

The vast difference between the beneficial effects of settled, reasonably permanent protection, and the hand-to-mouth variety which has been the portion of the dye industry during its years of struggle to maintain a footing in this country, were, perhaps unconsciously, emphasized by Senator Moses while voicing his remarkably empty protest against the adoption of the higher duties. He declared that if those interested in the industry had spent as much in their laboratories as they had in lobbying, the whole question of dye protection need not be before Congress. Of course, the New Hampshire Senator must know, if he has given a moment's attention to anything the dye people had to say, that if the industry could have been assured four years ago of continuous protection of the nature which it has actually received up to the present day, it would, in all probability, now be in a position to compete with its foreign rivals without the placing of an extraordinary handicap upon the latter. But the industry never knew what its status would be six months in advance—sometimes, indeed, very much less than that—and this condition, as has repeatedly been pointed out, checked the expenditure of capital for research, for systematic organization, and for other items essential to a successful march toward self-reliance, so that except in point of experience it is in many vital respects almost as far from being a well-rounded, self-contained enterprise as it was when it made its first plea for Governmental assistance.

The feeling of the industry is that if the present program is not seriously tampered with by the conferees, it will have protection enough to enable it to carry out its original plan for making America truly independent—which no country can be to-day without possessing a well organized coal-tar chemical manufacturing industry. The protection is certainly, in effect, everything asked for. In fact, from the standpoint of the consumer it is scarcely as desirable as the original embargo, which would have assured the country a complete line of colors of any variety without the necessity of paying stiff duties on those not produced here. Incidentally this illustrates well the enormous power of mere words and the associations which they call forth, for the Senate stuck at an embargo—and has passed a measure which is nothing more nor less than just that very thing, disguised as a protective tariff. Perhaps it is quite as well, for while some who voted against the proposed form of embargo doubtless saw its advantages to the consumer over a high-duty tariff, they voted against the embargo because it would be next to impossible to explain this difference in a satisfactory manner to constituents who would be blinded to anything but the cries of "Without precedent!" and "Un-American!" raised by the opposing forces in the Senate.

Yet, while it must be said that the very best way was not chosen and probably could not be chosen because of practical difficulties in the form of lack of universal public comprehension, the great benefits of the Bursum form of protection—even to consumers—as compared with little or no protection at all, are far too striking to need pointing out. Let there be no mistake about this. The consumer has not received the best treatment he could get, but he *has* received the best treatment possible to give him while coincidentally allaying an inherent public fear of a single word. That is the situation in a nutshell.

And the consumer will not be taxed by this measure beyond his endurance, nor even to such an extent as seriously to hamper him in competition. There are other high duties in the measure besides those on dyestuffs, and the consumer has not been left out. Finally, that he will benefit greatly in the long run by increased independence of foreign sources of supply and in a host of ways which never enter the head of the layman, can be denied by no one who has studied the facts.

The administration of such a measure as the conferees are now considering does not present serious difficulties. There is no reason to fear confusion. The control can be made as flexible as desired, for the head of the U. S. Customs Service may issue lists of products and the appropriate duties which can be followed by all Customs officials. These lists can easily be altered whenever necessary; they will provide the American dye manufacturers and consumers alike with an opportunity to ascertain just what comes into the country each month, and what duties were paid. Protests can be heard promptly, adjustments made, and most of the wrangling, red tape and exasperating delay occasioned by the licensing form of control can be eliminated. The higher duties will be applied to competing products—even when they are merely substitutes for competing products if it can be shown that they are being used as such—which should take care

of the dye manufacturers to their satisfaction, and the lower duties based on foreign valuation will be applied to the non-competing products, which gives the consumer the benefit. It will be seen that a very close watch can be kept by both sides, and that, moreover, the administration of the protecting law will be entirely automatic and speedily readjusted to meet changing conditions. In this respect it should prove more flexible and rapid in its action than an embargo which would hold disputed products on the other side or permit their importation only in bond until the case was decided.

All in all, the Senate, at least, is to be congratulated on its solution of what must be admitted was a very difficult problem. And if the House sees fit to let this measure stand unchanged, the dye industry will owe Congress a debt of gratitude which it can only pay—and which it will most willingly pay—by proving to the country its ability to guard against a repetition of the chaotic conditions of 1914-15.

A CORRECTION

In No. 7 of the series "Things Every Textile Chemist and Colorist Should Know," appearing on page 113 of the issue of August 14, the title was given as "Mercerization and the Action of Chlorinated Alkalis on Cotton," due to an error in the proofreading department. The title should read, of course, "Caustic Alkalis."

MORDANTS

By Wilder D. Bancroft

(*Continued from page* 150.)

used in dyeing light woolen stuffs, to which we may wish to give a delicate but brilliant shade. It is also employed in the dyeing of ordinary woolen goods, but here it is associated with alum, sulphate of iron, chloride of tin, etc. Its influence, under these circumstances, consists evidently in determining a double decomposition, from which we have produced a sulphate of potash or chloride of potassium, whilst the tartaric acid combines with the alumina, the peroxide of iron, or the oxide of tin. Now it is very probable that the colouring matters remove the alumina, the peroxide of iron, or the oxide of tin, more readily from tartaric than from sulphuric acid. Moreover, the presence of free sulphuric acid would certainly prove injurious, as well to the stuff as to the colouring matter, whilst free tartaric acid can exercise no unfavorable action over them.

"The operation of subjecting wool to the alum mordant is always effected at the boiling point; the mixture used in this process is a compound of alum and of cream of tartar. One of the objects of this addition is to free the bath of the carbonate of lime which the water generally retains in solution, and which, acting on the alum, would determine its partial decomposition by producing an insoluble subsulphate of alumina and potash, and this accumulating on the stuff, and becoming unequally fixed upon its surface, would lead to stains or blotches on passing the material through the dye-bath. But, independently of the above effect, which might be produced by any acid, cream of tartar appears to be capable of effecting a further object, by inducing a double decomposition, which transforms the alum into a tartrate of alumina. However this may be, after one or two hours' boiling in the alum-bath, the cloth which should be constantly agitated so as to cause a more equal application of the mordant, is withdrawn from the copper, and, after thoroughly draining, it should be put aside for two or three days, when we wish to dye it with any full-bodied colour. Experience has proved that this repose after the use of the mordant greatly favours the union of the latter with the stuff. In applying the tin mordants we also make use of cream of tartar. It is, moreover, an indispensable addition where we desire to fix the salts of iron previously to dyeing in black.

"Woolen cloth, on being dipped into a cold aqueous solution of alum, appropriates to itself a part of this salt, but without undergoing any very sensible alteration. MM. Thenard and Roard have, indeed, proved that cloth, when thus treated by a cold solution of alum, gives up this salt to boiling water, and that, after a few washings performed at the boiling point, it will have parted with the whole of the alum which it had received in the cold bath. When, however, cloth is boiled in a solution of alum, it yields to this liquid a portion of its organic matter, which becomes dissolved; but at the same time it absorbs an equal amount of the alum.

"We have now merely to show the action which wool undergoes when brought into contact with alum and cream of tartar at one and the same time. It is very possible that there may be in this case a simultaneous fixation of alum, as well as of the double tartrate of alumina and potash, and of tartaric acid. The presence of alum in the cloth when taken from the boiling solution is very evident; that of the tartrate of alumina and potash and of free tartaric acid is only presumable.

"Silk, in like manner, unites itself with alum when placed in a cold solution of this salt, and afterwards parts with it to boiling water; it may be reproduced from this liquor by evaporation. The action of silk on acetate of alumina is identical with that of wool. It at first absorbs this salt in its pure form; then, by mixture of the acetate together with alumina in its free state; it gives up a further portion of this acetate free state; it gives up a further portiono of this acetate to boiling water.

"The alum mordant is always used cold with silk: if employed hot, it would destroy its lustre. The bath should not contain cream of tartar when it is intended for this material; on the contrary, we here have recourse to a variety of alum of as neutral a character as possible.

"The theory of the action of mordants is connected in the closest manner with that of dyeing. It may, in fact, be viewed under two very different aspects. Sometimes we admit that there exists a true combination between the stuff and the colouring matter—a combination which can only be determined by a veritable affinity between these two bodies, and which will present a condition analogous to that which occurs in all chemical combinations—that is to say, a state of saturation, beyond which the union of these bodies becomes of a very unstable character; at other times, on the contrary we regard the dyeing of stuffs as produced by a nearly mechanical phenomenon, by virtue of which the colouring matters become imprisoned in the meshes of the organic filaments contained in the material to be dyed. This latter opinion is evidently the better founded. It approximates the theory of dyeing to some analogous phenomena which we find manifested by animal charcoal on coloured solutions; for, as the animal charcoal seizes upon the colouring matters contained in an aqueous solution, and renders them insoluble by fixing them in a purely mechanical manner within its own pores: so may the wool, the silk, and the cotton, appropriate the colouring matters held in solution, and, by fixing them in their pores, render them more or less insoluble to water. Experience, however, shews that dyeing thus produced is wanting both in intensity and in fixity—two qualities which it derives by the previous application of a mordant. Now, we can readily see that the mordants themselves may become fixed in the tissues by similar causes to othose which determine the fixation of the colouring matters by animal charcoal. We know, in fact, that this latter body possesses the property of removing from water not only the colouring matters, but also certain salts. There will, therefore, be no difficulty in imagining that silk, wool, and cotton may, in their character of porous bodies, purely and simply seize upon the alum, and that this salt, when once imprisoned in the meshes of the tissue, may subsequently react upon the colouring matter according as this latter, in its turn, penetrates the interior of these materials.

"We may then refer the phenomena of absorption, which characterise the fixation of the mordants and the penetration of the colouring principles into the tissues, to the same cause as that which determines the action of animal charcoal on certain soluble salts and colouring matters. But if one of these stuffs be impregnated with alum and then dipped in a bath of soluble colouring matter, it acquires a very deep tint, which appears to be essentially produced by a kind of lac, formed by means of the colouring matter and the base of the mordant. On the other hand, in a great number of cases, the mixture of the above mordant with the dye-bath fails in producing an insoluble precipitate. Thus, when we mix together alum and a decoction of Brazil-wood, no precipitate is formed, and, to obtain a lac from this liquor, we are obliged to add some alkali or alkaline carbonate, such as ammonia; in a word, we must render the alumina free. While admitting, then, in accordance with the experiments of MM. Thenard and Roard, that the stuffs fix the alum in its natural state, we must acknowledge, at the same time, that, by some special action, the tissue subsequently determines the union of the base of the mordant with the colouring matter. This special action is equivalent to that of the alkali.

"Now, it is certain that the above-mentioned stuffs possess in a high degree the faculty of seizing upon the insoluble colouring matters when these are presented to them in their nascent state. It is thus that cotton becomes dyed of a rose colour in a liquor which contains carthamic acid in suspension, arising from the decomposition of a carthamate of soda by an acid. In like manner we find wool acquires a black colour, when placed in a boiling solution of a salt of iron and tannin, by attracting to itself the black precipitate resulting from their admixture. Consequently, although the dyer generally endeavors to produce the insoluble compound, on which the colouring stuff depends, within the very pores of the tissue, still we may affirm that, in many cases, the cloth or other material, when placed in presence of the nascent precipitate, has the property of seizing upon it, and thus acquiring a shade of greater or less intensity.

"It is to this property (which is due to some hitherto undetermined cause) that we must undoubtedly refer the reaction which takes place between the alum and the soluble colouring matters, as well as some of these more mysterious phenomena which are manifested in dyeing. How else, indeed, are we to account for the fact that wool so readily takes a scarlet colour, while cotton and silk are unable to fix it? How explain the cause of wool so easily appropriating the black precipitate formed by tannin and the salts of iron, while silk, under the same circumstances, acquires a black colour only by great trouble and expense? How, in one word, can we understand why certain colours should fix themselves better on certain materials than on others, unless it be by virtue of some special action, wrongly designated by the name of affinity, but which does not the less constitute a force, or rather a consequence of diverse forces of which we must take full account during the operations of dyeing? To confound, in fact, a chemical affinity properly so called, such as is evidenced in ordinary chemical combinations when produced in definite proportions, with the phenomena of dyeing, is certainly to mix together two very distinct ideas. The union of silk with Prussian blue, or of wool with indigo, is quite a different thing to the combination of sulphur with lead. But to consider the tissue as a simple filter, capable of retaining in its pores certain principles, and of receiving from them peculiar colours, is to go equally far in an opposite direction; nor would this suppo-

sition at all explain the mode in which the coloured lac is formed in most of the operations of dyeing, operations which are effected by an aluminous salt and a colouring bath, altogether incapable of producing any lac, except by the addition of an alkali for the purpose of setting the alumina at liberty, or of a stuff which has the power of taking up the lac, as quickly as it is formed.

"Among the reasons which induce us to regard the insoluble colouring matters and the stuffs as capable of uniting together by virtue of some special force, we must mention the facts elicited by the recent experiments of M. Chevreul, who has found that the stuffs and colours, when once united form products which are endowed with properties differing, according to the nature of the stuff, in the same given colour. The properties of the dyeing matter are, then, greatly modified by the peculiar action of the tissue on the dye. Numerous examples place the truth of this assertion beyond all question. It becomes, therefore, perfectly clear that it is only by an attentive and systematic study of the specific properties of the stuffs, in their relation to the various dyeing matters which we may desire to fix upon them, that we can hope to direct the future progress of the art of dyeing."

On the other hand [27] "Chevreul denied that the alum could be washed out by water, and Bolby stated that actual decomposition took place; a basic salt being deposited on the fibre, leaving the solution more acid."

Knecht, Rawson and Loewenthal [28] consider that "the mordanting of wool and silk appears to be analogous to the dyeing of these fibres, and to depend upon their acid and basic properties. Thus, wool boiled with a solution of aluminum sulphate fixes both the acid and the basic constituents of the salt; but, being possessed of more pronounced acid than basic properties, it absorbs the basic constituents more energetically than the acid one, and some free acid is left in the solution. By subsequent treatment with boiling water, more acid is extracted, and the alumina becomes more firmly combined with the substance of the fibre. It is noteworthy that only such salts which contain the acid and basic constituents in a comparatively loose state of combination are absorbed by the wool fibre. Thus, whereas the sulphates of aluminum, iron, chromium and copper are readily taken up from the boiling solution by the wool fibre, sodium sulphate or sodium chloride are not taken up at all. Chromic acid, on the other hand, is readily taken up by wool, and, like the acetates of the heavy metals, is precipitated from its aqueous solution by lanuginic acid."

Thenard and Roard believed that aluminum sulphate or alum is adsorbed by wool unchanged and that the elimination of the sulphate radical takes place when the mordanted fibre is dyed. Most of the work since then has been to the effect that wool does decompose aluminum sulphate more or less. If the recent writers had read the original paper by Thenard and Roard, there would have been no discrepancy to explain.

Havrez [29] showed that when relatively concentrated solutions of alum are used in mordanting wool, the mordant washes out readily and the wool is not dyed so deeply as when more dilute solutions of alum are used. He recommends not going above ten per cent alum, referred to the amount of wool. It has been found by von Georgievics [30] that from relatively dilute solutions of alum, more alumina than sulphate is taken up by wool, while the reverse is true for relatively concentrated solutions. At twenty-four per cent alum, referred to wool, the two are taken up in equivalent quantities. Thenard and Roard used twenty-five per cent alum, referred to the wool, so that their results are absolutely in accord with the most modern data. The whole trouble arose from their using a more concentrated solution of alum than is now customary.

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[2] "Philosophy of Permanent Colours," 1, 118 (1813).
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[4] Minajeff: "Zeit. Farben-Ind.," 6, 233 (1907).
[5] Thorpe: "Dictionary of Applied Chemistry," 3, 236 (1912).
[6] Toch: "Chemistry and Technology of Paints," 117 (1916).
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[9] "Ber. Deutsch. Chem. Ges.," 35, 1493 (1902).
[10] Barnes: "Jour. Soc. Dyers and Colourists," 35, 59 (1919).
[11] "Philosophy of Permanent Colours," 1, 392 (1813).
[12] Bancroft: "Philosophy of Permanent Colours," 1, xxxi (1813).
[13] Ibid, 1, xxxiii (1813).
[14] "Philosophy of Permanent Colours," 1, xxxv (1813).
[15] "The Manufacture of Mineral and Lake Pigments," 46 (1901).
[16] Cf. Napier: "A Manual of Dyeing," 120 (1875).
[17] Bancroft: "Philosophy of Permanent Colours," 1, vii (1813).
[18] Gay-Lussac and Thenard have supposed these productions to be compounds of potash and soda with hydrogen (or hydrures), and Curadau has thought them to be compounds of charcoal, or charcoal and hydrogen, with potash and soda.
[19] Collected Works, 5, 122, from Phil. Trans., 1808.
[20] Ibid., 4, 262; from "Elements of Chemical Philosophy," (1812).
[21] "Elements of Inorganic Chemistry," 419 (1858).
[22] "Elements of Chemistry," 1, 293 (1830).
[23] "Philosophy of Permanent Colours," 1, 384 (1813).
[24] Berthollet, tom. i. p. 80, after saying that in aluming stuffs the latter decomposes the alum and combine with the alumine, while the acid which held it dissolved separates and remains in the bath, adds: "Mais il ne faudrait pas conclure de là, qu'aucune portion de l'acide ne reste dans la combinaison de l'étoffe où elle peut avoir quelque influence sur la couleur."
[25] It was completely ascertained that when wool had been so alumed, the alum employed might be all recovered, partly from the bath or liquor in which the aluming had been performed and partly from the wool itself, by repeatedly washing the latter in pure boiling water: commonly a dozen separate washings were sufficient to remove completely all the alum which had united itself to the wool; and the alum, so separated, was susceptible of a distinct crystillization, as if it had never been so employed. After the last of these washings, the wool or cloth so washed was found to be as incapable of receiving colors by dyeing as if it had not been so alumed; and, indeed, before the last it was always found that the color attempted

vessel by the affinity of the adjective coloring matter, their co- to be dyed upon it was feeble in proportion to the number of washings which had taken place.

It became evident, therefore, from these experiments that wool or cloth boiled with alum (and tartar) attached to itself the undecomposed alum only, and that a decomposition of the latter does not take place until the subsequent operation of dyeing, when, the affinity of wool being assisted in the dyeing operation separates the alumine, in a great degree at least, from the sulphuric acid.

[26] "Manual of Dyeing," 200 (1875).

[27] Dreaper: "The Chemistry and Physics of Dyeing," 61 (1906).

[28] "A Manual of Dyeing," 20 (1910).

[29] "Dingler's Polytech. Jour.," 205, 491 (1872).

[30] "Jour. Soc. Chem. Ind.," 14, 653 (1895).

The Direct Colors

Strong Colors—Effect of Diazotization—Production of Direct Colors—Stilbene Dyestuffs —Fast Direct Dyes

By E. GREENHALGH

THE direct cotton colors hold one of the foremost positions in the broad realm of artificial coloring matters; in fact, there is scarcely an industry in which dyestuffs are employed where the direct colors emphasize themselves by their absence.

They find application in the dyeing and printing of all classes of cotton goods and are notably made use of for the production of discharge styles; in paper staining these dyestuffs lend themselves admirably to this class of work, particularly those products of the stilbene class, and other industries such as leather dyeing, linen and straw dyeing, besides being utilized in the wool industry. Silk and artificial silk can be dyed with some of these products, and their capability of dyeing animal and vegetable fibers has caused many of the members to be classed and used as union colors.

Strong Dyes

These substantive colors are tinctorially strong, giving in many instances clean and pure shades, and are very easy of application. The direct colors are nearly all polyazoic in constitution, that is, they usually contain the usual azo linkages and are therefore developments on the simpler azo dyes which constitute many of the wool colors. In contrast to these wool colors it is found that the bases of many of the substantive dyes are derived from condensed diamines such as benzidine, tolidine, cumidine and dianisidine, which after diazotization are coupled up with various naphthol sulphonic acids or other groups. In this manner the first direct color, namely, Congo Red, was produced by acting on benzidine with nitrous acid, forming the necessary diazo groups, and coupling with naphthionate of soda. The chemical form of these diamines, such as benzidine, are all of one type, and the following graphic formula will show the type of substance these products claim to be:

$NH_2.C_6H_4—C_6H_4NH_2$
Benzidine

$NH_2.C_6H_3.CH_3—CH_3.C_6H_3.NH_2$
Tolidine

$NH_2.C_6H_3.OCH_3—OHC_3.C_6H_3NH_2$
Dianisidine

Effect of Diazotization

As will be seen, each of the above contains two NH_2 or amido groups, and these are the groupings altered by diazotization, the NH_2 group becoming on treatment with nitrous acid in hydrochloric acid solution N—NCl, so that one molecule of benzidine, for instance, is capable of attaching itself to two molecules of a naphthol sulphonic acid or its equivalent such as a phenol, monamine or diamine, etc.

Again, it is possible to attach only one molecule of the coupling body to one diazo group, coupling a different molecule to the other diazo group. Diamine Fast Red F gives an example of this. The production of this product may be briefly given as, benzidine + salicylic acid + 2 : 8 amino—naphthol 6 sulphonic acid.

Many of the direct colors are produced in a similar manner by using different bases, other than benzidine, along with the various phenols, diamines and the whole range of the sulphonic acids of naphthol, amino-naphthol, etc. It will have been noticed that by adding on a diamine or amino-sulphonic acid new groups capable of further diazotization have been obtained, and these in their turn can be made to attach similar coupling bodies as before, so that it is possible, theoretically speaking, to go on *ad infinitum*.

This capability of a second diazotization is, however, made use of extensively for the production of more complex dyestuffs, but only very rarely is there required a further process of treatment with nitrous acid.

Colors produced in this manner have resulted in the attainment of dyestuffs possessing higher tinctorial power, and faster resistances, and many of the "diazo" colors are of this type and require to be diazotized on the fiber after application and afterwards coupled with a suitable developer in order to fully produce the color, or in some cases the color needs only developing by treatment with certain products. An example of this type is Diamine Black BH or Diazo Black BH, which is made from benzidine coupled in specified ways with molecules of 2 : 8 amino-naphthol 6 sulphonic acid and 1 : 8 amino-naphthol 3 : 6 disulphonic acid H. As will be seen, there have been two amino groups added capable of further diazotization and coupling.

Again, a dyestuff itself may be attached to a separate diazo body such as diazotized para-nitraniline, giving a new product possessing qualities far exceeding its original capabilities. Diamine Bronze G gives a good example of this type of color, which in its application is first dyed on the fabric, giving a dull, grayish brown color, and finally is treated in a bath containing diazotized para-nitraniline, when a full rich color, fast to light and washing, and of good dischargeability, is produced by the union. Diamine Bronze is made from benzidine by coupling an H acid and salicylic acid, diazotizing further and adding meta-phenylene-diamine, which latter body containing two amino groups is capable of still further diazotization if necessary, or of attaching itself to an already diazotized base.

Production of Direct Colors

The following examples will give some idea of the various methods and intermediates adopted for the production of some of the better known direct colors:

Congo Red from benzidine and naphthionic acid made into sodium salt.

Benzo purpurin 4B from tolidine and as for Congo Red.

Chrysamine from benzidine and salicylic acid.

Benzo Orange R from benzidine, salicylic acid and naphthionic acid.

Toluylene Orange R from tolidine and meta-toluylene diamine sulphonic acid.

Toluylene Orange G from benzidine, toluylene diamine and cresotinic acid.

Direct Blue 2B from benzidine and H acid (1 : 8 amino-naphthol 3 : 6 disulphonic acid).

Diamine Pure Blue from dianisidine and H acid.

Chicago Blue from dianisidine and 1 : 8 amino-naphthol 2 : 4 disulphonic acid.

Benzo Indigo Blue from benzidine, alpha-naphthylamine and 1 : 8 dihydroxy-naphthalene 4 sulphonic acid.

Columbia Black from tolidine, 2 : 8 amino-naphthol 3 : 6 disulphonic acid and meta-toluylene-diamine.

Diamine Green from para-nitraniline and H acid coupled on to benzidine, then adding phenol for B shade or salicylic acid for G shade.

Direct Deep Black from benzidine, H acid and naphthionic, afterwards coupling with meta-phenylene-diamine.

The above dyestuffs will be seen to be products which can be made with well-known intermediates and bases and, although amongst this class there are quite a large number of direct dyestuffs, still there remain more important bodies from which many other direct dyes are derived. Chief amongst this class of bases is the substance stilbene, from which is made by the necessary introduction of amido and sulphonic groups the product diamido-disulphonic acid of stilbene, which when diazotized and coupled with phenols, salicylic acid, etc., gives rise to a unique class of bodies, amongst which is found the dyestuff Chrysophenine, which is a diethyl derivative of one of these couplings ethylated to render the dyestuff fast to alkalis.

The direct fast yellows and oranges, such as Sun Yellow and Mikado Orange, are all derivatives of stilbene, although made in a different way.

Closely allied to this class of colors are those dyestuffs which are produced from the intermediate dehydrothio toluidine, and comprise many well-known colors such as Primuline, Erica, Brilliant Geranine, Diamine Pink, Columbia Red and Diazo Brilliant Scarlets.

Stilbene Dyestuffs

The stilbene dyestuffs from one of the most important branches of the body of substantive dyestuffs and their manufacture, although seemingly simple (being at times only a condensation by the use of various strengths of alkali) becomes rather complex when analyzed as to the various steps through which the product goes before the final color is obtained. Their use as paper staining colors and dyes for reasonably fast shades on cotton practically places them in the very forefront of direct colors for utility and importance.

As will have been noticed, the various naphthol sulphonic acids and amido sulphonic acids play a very big part in this branch of dyestuff chemistry; in fact, the use of them is so abundant that they are mainly responsible for the large number of substantive colors now available. Yet amongst these various naphthol acids there is one member which calls for special consideration, and that is the substance going under the unassuming name of J acid or, to describe it fully, 2 : 5 amido naphthol 7 sulphonic acid. This acid and its homologues, *e. g.*, the methyl, phenyl, acetyl J acids, etc., can by treatment with a substance called phosgene (which is very often used in this capacity) be made to condense with themselves giving a product having practically double the molecular weight of the original.

Fast Direct Dyes

By attaching this molecule to various other bases, such as amido-azo-benzene or toluene, diamines, etc., colors of

the type of Benzo Fast Red and Benzo Fast Scarlet are obtained, while if the phenyl or acetyl J acids be employed in a similar manner bluer dyestuffs result, such as Benzo Fast Bordeaux, Benzo Fast Rubine and Brilliant Benzo Violets.

Other dyestuffs possessing exceptional fastnesses and purity and clarity of shade and tone belonging to this class of J acid derivatives are the rosanthrene colors, Diazo Brilliant Reds and Scarlets, some of the Zambesi Reds, *e. g.*, the 8B brand, and many others too numerous to mention. Practically all the direct colors derived from this particular amino-naphthol sulphonic acid are characterized by their brilliance and their resistance to the attacks of light and washing, and thus make themselves indispensable to the dyer's stock pattern card.

There is still an important class of dyestuffs used particularly for the production of fast lining discharge styles, and among the members the dyes Diaminogene Blue and Oxydiaminogene are found. These products are derivatives of diamines of the naphthalene system of compounds, and the blue and black may briefly be given as follows:

Diaminogene Blue from 1 : 4 diamino-naphthalene sulphonic acid + alpha-naphthylamine + 2 : 6 naphthol sulphonic acid.

Diaminogene Black as above but substituting the last group by 2 : 8 amino-naphthol 6 sulphonic acid.

There are many colors giving similar shades to the diaminogenes on the market, and they are all alike save possessing varying end components, but the diamine is invariably one of those belonging to the naphthalene series.—"Dyer and Calico Printer."

Preparation of Cloth for Finishing

Tallow Should Be Free from Paraffin—Needless Risks—A Dubious Saving—Effects of Paraffin in Dyed Goods Chemical Causes of Stains—Purity of Supplies—Bleeding of Dyestuffs

From a Paper Read Before the British Association of Managers of Textile Works

IT is difficult for the finisher to understand why some cloths are found to contain as much as 2.5 per cent of fatty matter, while other similar cloths contain only 0.6 per cent.

Tallow is the fat largely used in sizing mixings, and it should be borne in mind that many commercial tallows are adulterated with paraffin wax, which, being unsaponifiable, is not removed by the process of bleaching and gives rise to stains of various character in the finished goods.

Tallow Should Be Free from Paraffin

Commercial "tallow" has been found to contain as much as 50 per cent of unsaponifiable matter, and tallow has been sold to manufacturers as pure beef tallow and found to contain 15 per cent of paraffin wax. A guarantee should be obtained that the tallow bought is free from paraffin, and then the seller could be made responsible for any trouble caused. Cases are within our knowledge o spermaceti wax being used in sizing mixings which, being unsaponifiable, cause trouble in finishing. Such paraffin or wax stains in finished cloth are of a particularly objectionable character, as they are invisible in the gray, incapable of being removed by any ordinary bleaching process, and almost invisible in the white cloth. The affected parts of the cloth, however, resist dyeing and finishing. C. O'Neill has pointed out that Japan wax is not suitable for sizing mixings. It is only partially saponifiable, and therefore not readily removed in the scouring operations.

Needless Risks

A manufacturer writes that a size containing soap, paraffin wax and paraffin oil is used for light sizing because it is cheaper than tallow, and he asks if it should be condemned. It may be that, the soap being in a larger amount than the mineral wax and oil, the separation of the wax and oil from the emulsion would not be likely; but at the time there is no reason to use these substances, and we wish to press home to manufacturers that they are running a risk by using these substances at all.

Recently a case of paraffin wax staining came to our notice where it was evident the trouble was caused in using blocks of paraffin wax for rubbing on the threads during weaving in order to lubricate them. Now, the wax taken up in this way is small, but when we have 4 tons of cloth in a kier and the wax in the cloth melts and gets on a few pieces of cloth there is quite sufficient to cause trouble. Paraffin and similar waxes should not be allowed in the weaving shed.

Tallow in Place of Paraffin Wax a Dubious Saving

A manufacturer recently stated that the adoption of tallow in place of paraffin wax for sizing might mean £100 a year to a weaving shed. Wax is about £30 a ton and tallow £40, so you can soon figure out what difference it would make. Then, consider what risks you are taking of having faults thrown back on you. Any paraffin wax found in the cloth can easily be de-

tected by a trained chemist, and the trade knows that only the sizer can be blamed for it. The saving is not worth the risk, and a great effort should be made in the interests of the industry to eliminate paraffin absolutely from the sizing and weaving branches of the industry.

Mr. Sagar, at the World Cotton Conference, asked that a committee of experts be formed to construct a best size for weaving purposes. No doubt some action on these lines would be useful, but the great point is to convince manuacturers of the benefits to be gained by cooperation and abandoning the use of sizing of materials known to be an obstacle to the achieving of the best by the finisher.

Several Examples of the Effect of Paraffin in Dyed Goods

Under the heading of stains due to paraffin it may be useful to refer to a similar trouble which arises from time to time from the practice of covering up a float or other weaving defect with paraffin wax or soap containing it.

Although only a single float in a lump may have been so treated, when that lump is put into a kier along with 2 tons of cloth the paraffin melts, floats about in the kier and may stain many lumps with all sorts of irregular shaped stains, for which the finisher has to accept the responsibility owing to his being quite unable to trace them back to their real source. Warps have been known to be tinted with a yellow dyestuff to make them appear like Egyptian cotton. The dyestuff could not be bleached out, but spread a yellow tint over the cloth and damaged it. For some classes of weaving the tinting of the warps is said to be an advantage, and blue tinted warps are sometimes used in Jacquard looms; but great care should be taken that the dyestuff used is easily removed in the bleaching process. Yellow ochre has been used in sizing mixings and has caused trouble in the subsequent bleaching of the cloth.

Chemical Causes of Stains

Among chemical causes we include stains due to mineral oil which may have come in contact with the yarn or cloth in the course of spinning and weaving, from drippings from the roof or from the slasher cylinder covers, yellow or black bars from cracked bobbins, the oil getting on the roving or oil from the roller necks and in the top boards in the cardroom. When the weaver pieces a thread an oil stain will result if she has oil on her fingers, and this stain cannot be removed in the ordinary bleaching process. Marks from picker bands due to oily and waxy matters in the stuffing of the leather will not come out, but leave yellow marks. If the stains are from pure oil they show up yellow in the finished piece, but if the lubricating oil has come from a bearing and contains any copper or iron from the machinery, then the trouble is greatly aggravated. Cases have been known of pieces of cloth falling in two pieces at the finishing owing to one warp thread containing such metal contaminated oil, the thread consequently having become tender in the process and also tendered the weft.

When the cloth containing such oil is well scoured, part of the oil may be removed but not the metallic particles, and these are rarely completely removed by the subsequent scouring. They remain in the cloth and are frequently quite invisible in the white goods, but become visible either as resistant places to the colors subsequently applied or as colored stains in the white portions of dyed goods, and when such goods are chemicked to produce the ultimate white required the metallic particles act on the chemic, giving off oxygen and tendering the cotton with which they are in contact. If the contamination has taken place in the spinning, single threads may only be affected, producing cuts in the cloth; but if the stain has spread to more than one thread, as would be the case if they are caused in weaving, holes may result.

Attempts are made at times at the mill to remove these metallic stains by treatment with oxalic acid or salts of sorrel, but this is an exceedingly dangerous practice, because if the acid is not completely removed by washing, local, and perhaps more than local, tendering is likely to result.

Purity of Supplies

A Belfast manufacturer at one time tried to get rid of oil stains entirely and he succeeded to a large extent; but when the looms were standing at the weekend he found it practically impossible to prevent contamination. These were Jacquard looms with complicated overhead harness. He then used an oil which was saponifiable in the bleaching, and the oil stains were thereby greatly reduced until he got a delivery of oil which was badly adulterated. This oil showed the well-known bloom of mineral oil and contained very little animal oil. The manufacturer has these troubles of purity of supplies to contend with as regards the fats he buys for his size, his softeners and his lubricating oil, and on this account we cannot expect our troubles under these heads to cease entirely no matter how careful the manufacturer is.

Some years ago it was shown that by using a lubricating oil containing 75 per cent of colza oil and 25 per cent of mineral oil any oil stains would be removed in the bleaching process. It would be interesting to note if such an oil has been adopted to any large extent in the weaving industry. Experience shows that in a matter of this kind a slight difference in cost is the factor that decides adoption or rejection.

White lead stains from looms and other parts of the

textile machinery will not bleach out, but leave light brown stains.

Bleeding of Dyestuffs

The bleeding of dyestuffs in the bleaching process causes a lot of trouble, and probably always will. The question was asked at the Cotton Conference whether we were encouraging certain yarn dyers, who we know produced fast colors, at the expense of other yarn dyers; but it was pointed out that we were acting in the interests of the trade in general—that is, endeavoring to minimize faults under this head. We feel that even if co-operation takes place on this matter we have always the human element to consider. Moreover, it is more likely for variations to take place in the process of dyeing, which is sometimes a long and difficult one, than in the process of bleaching, which is more or less standardized. For instance, turkey red for headings is sometimes a variable color. Dyed by the old process, it is said to be faster than by the new one, and rancid olive oil is stated to give a better product than turkey red oil. Some vat colors are used by manufacturers to which the dyers will give no guarantee. The manufacturer takes the risk and the finisher does his best, but if occasional bleeding takes place for no reason, then the finisher of the cloth or the dyer of the yarn can explain. The manufacturer must always remember he is using colors which are not guaranteed for the cloth he is producing. The merchant likes the headings, but the goods are finished with, every time.

Immediately after the Cotton Conference a committee was formed to go into the question of the fastness of colors to bleaching. There are difficulties in the matter, but the committee is making headway. Then, we have recently had the laundries putting in their word on this matter. Perhaps this industry can again be roped in and work of general importance done.

DYES FROM KAOLIANG BRAN

A method of securing dye from kaoliang bran has been discovered by mixing it with soda, sulphate, etc., according to Consul M. D. Kirjassoff, Dairen, Manchuria. The brown and black dyes produced by this process have been patented and a patent has been applied for to cover blue-black. Kaoliang bran may be obtained in practically unlimited quantities in Manchuria, delivered at stations of the South Manchuria Railway, at approximately 1.80 yen per 100 kin. Cost of production of black dyes is about 15 yen per 100 kin, to be sold at 25 yen per 100 kin; of brown dyes, about 60 yen per 100 kin, to be sold at 70 yen per 100 kin; and of blue-black dyes, about 25 yen per 100 kin, to be sold at 35 yen per 100 kin. (The present value of the yen is about 48 cents; the kin is equal to 1.32 pounds.)

American manufacturers interested in this report may obtain further particulars, including the name of the inventor, from the Far Eastern Division, Bureau of Foreign and Domestic Commerce, by referring to file No. 50943.

PRINTING OF BRONZE COLORS

By J. Besancon

VARIOUS metallic pigments have long been used for the purpose of decorative printing on fancy dress fabrics, draperies and upholstery goods. At the present time, a large number of novelties are being introduced in the market. The most primitive process consisted in simply printing on the fabric a gum lacquer in which was mixed a metallic powder, then aging and drying. Goods finished in this manner, however, were not fast to washing.

Later on, better results were obtained by mixing the bronze powder with a fixative capable of being used at the same time as a thickener. For this purpose there was used a solution of rubber and wax in benzene and camphor oil and also some copal resin.

For a number of years large quantities of dyed goods, such as black and blue satinettes, have been printed in English mills in this manner with gold and silver powders. Some of the decorative effects thus obtained are very beautiful, and the printed parts are brilliant and satisfactorily fast. But a solution of rubber and a varnish is capable of being employed in only very limited styles of printing; consequently attempts have been made to devise methods that would be free from these limitations.

The use of gelatine has been tried on account of the property possessed by this substance of becoming coagulated to an insoluble form when treated with various reagents. The best of these coagulants, perhaps, is formaldehyde. Bronze powder, intimately mixed with a solution of gelatine is printed on by means of rollers; then the cloth is steamed in an atmosphere of formaldehyde vapors. For this purpose, Jeanmaire in the mill of Koechlin Freres at Mulhouse used a thick solution of cellulose in cuprammonium. This solution, mixed with the metallic powder, can be printed easily, and as it can be associated with other steam colors, the process lends itself very readily to the production of multicolored effects. On drying and steaming the printed goods, the ammonia is driven off, and the cellulose fiber mixed with the bronze powders is left fixed very firmly in the fabric. The cellulose compound, however, has a greenish color owing to the presence of the copper oxide which is precipitated when the ammonia is expelled. In order to get rid of this green color, the goods are first decatized and then passed through a solution of sulphuric acid. The maximum luster of the metallic powder is then developed by calendering.

Another method which has been developed is the use of gelatine solution mixed with the metallic powder and combined with the coagulant in a latent form. This was suggested as a printing paste by Stephan in 1901, who used formaldehyde as the coagulant in the form of its

ammonia compound. The printing paste was prepared with bronze powder, formaldehyde, ammonia, and a solution of gelatine in water with the addition of some resorcinol. The function of the last-named material was to prevent the "setting" or coagulation of the concentrated gelatine solution, and to facilitate thus the operation of printing. Phenol also exerts a similar influence in keeping the gelatine solution fluid. After drying and steaming (or decatizing) the ammonia compound of formaldehyde is dissociated, and the liberated formaldehyde coagulates the gelatine and thus fixes the metallic powder.

A year later (1902) Heilman & Co., described a somewhat similar method, but replaced the gelatine with acetyl-cellulose (Sericose), and also used formaldehyde and phenol. Under the influence of heat the formaldehyde and phenol are converted into a synthetic resin (Bakelite or Redmanol), and this product acts very nicely as a thickener as it is readily miscible with the bronze powder and dissolves the acetyl-cellulose. After steaming it remains as an insoluble fixative, holding the metallic pigment.

Shortly before the war, a notice appeared, stating that the mill of N. Konschine at Serpoukoff, Russia, was using Sericose as a fixative and thickener. Frossard and Rebert, who were chemists at Konschine's mill, addressed a note to the Industrial Society of Mulhouse in which they set forth the principle of the process used by them. The Konschine method differed from the Heilman process by a greater simplicity, since formaldehyde was not used, only phenol (or resorcinol) and acetone (or alcohol) for dissolving the Sericose. The printing paste could be applied with copper rollers, and could be associated with the use of other dyestuffs, or even with discharge colors or with substantive colors. After steaming, the metallic print was very fast, and could withstand all of the processes used in connection with printing colors, such as treatment with tartar emetic solution, soaping, calendering, etc.

A little later the mill of Emile Zundel at Moscow developed a further process of bronze printing. Instead of using acetyl-cellulose (Sericose) to fix the metallic powder there was utilized the fixative property of the synthetic resin produced as a condensation product of formaldehyde and phenol. The Zundel method reduced the process to its simplest form. The Zundel patent was under discussion for some time as conflicting with the Bakelite patent, though finally its novelty was allowed in that it produced a new technical effect by the use of an already well-known compound. The Zundel process probably constitutes the first practical solution of the problem relating to the permanent fixation of bronze powders by the customary process of roller printing, and may be employed in connection with steam and discharge colors. —"Revue Textile Chemie Colorante," through "Canadian Dyer and Color User."

A novel process for the retting of bast fibers is the use of organic solvents like ethylene dichloride, ethylene trichloride, ethylene perchloride, dimethyl tetrachloride and dimethyl pentachloride. It is claimed that these solvents are capable of separating the fibers at temperatures as low as 160 deg. Fahr. It would appear, however, that as far as the commercial possibilities of this process are concerned, the solvents mentioned are all too costly to be available. They might serve for laboratory testing of fibers.

Foreign Dyes Licensed by Treasury Department for July Import

Licensed German-Made Importations More Than Cut in Half—Swiss Send Only One-Quarter of June Contribution—17,690 Pounds from England

The Dye and Chemical Control Section, Division of Customs, Treasury Department, issued licenses during July for the importation of 130,386 pounds of dyes from Germany, compared with 214,514 from Germany in June; 17,690 pounds from England, against 4,000 pounds in June; 47,406 from Switzerland, against 182,631 pounds in June. There were no licenses issued for imports from France in July and none in June.

The dyes from England for which licenses were issued include: Alizarine Green S 15% Paste, 1,500 pounds; Alizarine Orange AO 20% Paste, 2,000 pounds; Chambertine Lake, 2,200 pounds; Cross Dye Green 2G Conc., 500 pounds; Madder Lake, 990 pounds; Ueta Chrome Olive Brown G, 500 pounds; Thionol Brown O, 5,000 pounds, and Thionol Brown R, 5,000 pounds.

The July licenses issued for imports of dyes from Germany and Switzerland follow:

Designation of Dye	Germany (lbs.)	Switz. (lbs.)
Acid Alizarine Gray G	2,115	....
Acid Rhodamine BG	100	....
Acid Rhodamine R	....	26
Acid Rhodamine 3R	....	110
Algol Blue 3G	485	....
Algol Brilliant Violet R Pdr	130	....
Algol Corinth R Pdr	10	....
Algol Red 5G Pdr	10	....
Alizarine VI Extra Pure for Lake 20%	1,000	....
Alizarine Astrol B	70	....
Alizarine Black S Paste for Printing	1,000	....
Alizarine Black WX	50	....
Alizarine Blue S	2,640	....
Alizarine Blue SKY	550	....
Alizarine Blue WAS	500	....
Alizarine Blue Black 3B	1,000	....
Alizarine Cyanine Green E	200	....
Alizarine Cyanine Green G Ex. Pdr.	200	....
Alizarine Cyanine Green 3G	800	....
Alizarine Direct Violet R	500	....
Alizarine Emeraldole G	100	....

Designation of Dye	Germany (lbs.)	Switz. (lbs.)
Alizarine Geranole B	25	....
Alizarine Green C	200	....
Alizarine Green S Paste	500	....
Alizarine Indigo G Paste	200	....
Alizarine Indigo Green Paste	1,500	....
Alizarine Irisol R	625	....
Alizarine Light Blue SE	....	1,000
Alizarine Maroon 20% Paste	1,300	....
Alizarine Red IWS Pdr	2,000	....
Alizarine Red W Pdr	672	....
Alizarine Rubinole 3G	505	....
Alizarine Rubinole GW	500	....
Alizarine Rubinole R	1,970	....
Alizarine Saphirole SE Pdr	50	....
Alizarine Saphirole WSA	200	....
Alizarine Sky Blue B Pdr	2,350	....
Alkali Fast Green 3G	110	....
Anthosine 5B	110	....
Anthracene Blue WR Paste	210	....
Anthracene Brown RD Paste	....	1,500
Anthracene Chromate Brown EB	600	....
Anthra Cyanine S	....	220
Anthracyanine Brown GL	50	....
Anthracyanine Brown RL	50	....
Anthracyanine Green 3GL	50	....
Anthraflavone GC Paste	1,500	....
Anthraquinone Blue SE Ex. Pdr	100	....
Anthraquinone Violet	100	....
Anthrazurine G	200	....
Azo Acid Black 3BL Extra	500	....
Alizarine Blue Black B	1,300	....
Benzo Fast Blue 3BX	100	....
Benzo Fast Blue 2GL	395	....
Benzo Fast Blue 4GL	1,330	....
Benzo Fast Bordeaux 6BL	1,035	....
Benzo Fast Brown GL	30	....
Benzo Fast Brown 3GL	500	....
Benzo Fast Brown RL	625	....
Benzo Fast Eosine BL	5	....
Benzo Fast Heliotrope BL	750	....
Benzo Fast Heliotrope 5RH	5	....
Benzo Fast Heliotrope 2RL	570	....
Benzo Fast Orange 2RL	335	....
Benzo Fast Red 8BL	1,035	....
Benzo Fast Red 9BL	160	....
Benzo Fast Rubine BL	235	....
Benzo Light Gray BL	1,100	....
Benzo Red 12B	2,000	....
Benzo Rhoduline Red 3B	200	....
Benzo Violet O	10	....
Black Base S	15	....
Brilliant Anthrazurol G Pdr	75	....
Brilliant Azurine 5G	990	....
Brilliant Benzo Fast Heliotrope BL	200	....
Brilliant Benzo Fast Violet 4BL	180	....
Brilliant Benzo Green B	180	....
Brilliant Benzo Violet B	25	....
Brilliant Chrome Violet B Pdr	....	10
Brilliant Fast Blue GG	500	....
Brilliant Indigo N	1,000	....
Brilliant Rhoduline Blue R	1,320	....
Brilliant Sky Blue 8G Extra	1,005	....
Brilliant Wool Blue FFR Extra	15	....
Chinoline Yellow KT Ex. Conc	1,500	....
Chloramine Brown G	5	....
Chloramine Red 8B	....	3,300
Chloramine Red 8BS	710	....
Chloramine Fast Blue RL	....	660
Chlorantine Fast Blue 2GL	....	242
Chlorantine Fast Blue RL	....	1,441
Chlorantine Fast Brown 3GL	....	936
Chlorantine Fast Brown RL	....	686
Chlorantine Fast Red 7BL	....	110
Chlorantine Fast Violet 2BL	....	1,100
Chlorantine Fast Violet 4BL	....	2,310
Chlorantine Fast Yellow 4GL	....	175
Chlorantine Fast Yellow RL	....	1,320
Chlorophyli C	....	15
Chlorophyli R	....	15
Chlorophyli S	....	15
Chlorophyli SK	....	15
Chromal Blue GC	....	1,000
Chromanil Black BF	500	....
Chromate Brown EB	1,100	....
Chrome Acetine Blue S	....	220
Chrome Azurine E	....	1,013
Chrome Azurine P	....	220
Chrome Brown TV	....	660
Chrome Citronine R	....	55
Chrome Citronine V	....	55
Chrome Purpurine JJ Pdr	....	112
Chrome Rhodine BN Pdr	....	112
Chrome Rhodine 6GN Extra	....	112
Ciba Blue 2B Pdr	....	242
Ciba Blue 2BD	....	2,000
Ciba Blue G	....	2,200
Ciba Bordeaux B Pdr	....	2,200
Ciba Rose BG	....	660
Ciba Scarlet G Pdr	....	220
Ciba Violet B	....	3,300
Ciba Violet R	....	1,069
Cibanone Blue 3G Paste Pat	....	2,200
Cibanone Brown B Paste	....	660
Cibanone Brown R Paste	....	550
Cibanone Green B	....	2,970
Cibanone Orange R	....	2,211
Cibanone Yellow R Paste	....	1,386
Cloth Fast Brown G	....	660
Cloth Fast Green G	....	880
Cloth Fast Yellow R	....	660
Columbia Black G Extra	500	....
Congo Orange R	200	....
Crystal Violet 10B	50	....
Crystal Violet Extra	205	....

Designation of Dye	(lbs.) Germany	(lbs.) Switz.
Cyananthrol RXO	55	....
Cyanole Blue	1,000	....
Cyanole Extra	50	....
Cyanole FF	350	....
Diamine Azo Blue R	100	....
Diamine Azo Orange 2R	10	....
Diamine Brilliant Scarlet S	75	....
Diamine Bronze G	300	....
Diamine Catechine B	100	....
Diamine Catechine G	200	....
Diamine Dark Blue B	100	....
Diamine Fast Black Extra	3,600	....
Diamine Fast Bordeaux 6BS	1,000	....
Diamine Fast Brown G	50	....
Diamine Fast Brown 3G	200	....
Diamine Fast Orange EG	500	....
Diamine Fast Orange ER	25	....
Diamine Fast Rubine FB	100	....
Diamine Fast Yellow R	200	....
Diamine Gray BN	25	....
Diamine Orange F	75	....
Diamine Orange G	10	....
Diamine Scarlet 3B	100	....
Diaminogene Blue BB	119	....
Diaminogene Blue NA	1,500	....
Diaminogene Extra	6,525	....
Diaminogene Sky Blue N	500	....
Diamond Green SS	500	....
Diamond Phosphine 2G	100	....
Diazamine Blue RR	....	7,500
Diazo Brilliant Black B	1,275	....
Diazo Brilliant Orange GR	200	....
Diazo Brilliant Orange GR Extra	500	....
Diazo Brilliant Scarlet 2BL Ex. Conc.	305	....
Diazo Brilliant Scarlet 3B Extra	10	....
Diazo Brilliant Scarlet ROR Extra Conc.	200	....
Diazo Brilliant Scarlet ROR Extra Conc. 70/100	50	....
Diazo Fast Bordeaux BL	250	....
Diazo Rubine B	275	....
Diazo Sky Blue B	700	....
Diazophenyl Black V	....	1,000
Diphenyl Brown BBNC	....	1,000
Diphenyl Catechine G	....	2,500
Diphenyl Chlorine Yellow FF Supra	....	1,000
Direct Blue 8B	10	....
Direct Brown 2G	....	660
Direct Chrome Brown B	50	....
Direct Clear Blue FF	10	....
Direct Fast Red 8BL	25	....
Direct Red 8BL	200	....
Direct Violet B	10	....
Eclipse Brown BK	....	7,500
Eclipse Brown 3GK	....	7,500
Erika B Extra	500	....
Erio Chromo Azurol BX	....	9,610
Erio Chrome Azural BX Conc	....	2,000
Erio Chrome Brown ROS	....	6,500
Erio Chrome Flavine A Conc	....	1,810
Erio Chrome Green O	....	1,000
Erio Chrome Red B	....	9,110
Erio Chrome Red G	....	2,500
Erio Chrome Verdon S	....	500
Erio Fast Cyanine SE	....	1,000
Erioglaucine AP	....	12,100
Ethyl Violet	2,000	....
Euchrysine GRNTN	400	....
Euchrysine RRX	55	....
Fast Chrome Green B	....	220
Fast Green Extra Bluish	1,500	....
Fast Mordant Blue R	300	....
Fast Red RL Base Paste	10	....
Fastigen B	260	....
Gallophenine D	110	....
Hansa Yellow 5G	100	....
Helindone Brown G	420	....
Helindone Green G Paste	4	....
Helindone Orange R 10%	25	....
Helindone Pink AN	250	....
Helindone Pink AN 10% Paste	325	....
Helindone Pink BN Paste	1,100	....
Helindone Pink BN 10%	100	....
Helindone Pink R Extra	1,100	....
Helindone Red B	415	....
Helindone Red 3B	1,525	....
Helindone Yellow CG	100	....
Helio Fast Violet AL	40	....
Hydron Bordeaux B Dbl. Paste	50	....
Hydron Bordeaux R Dbl. Paste	50	....
Hydron Brown G	1,200	....
Hydron Brown R Paste	100	....
Hydron Green G Paste	100	....
Hydron Pink FF	5,415	....
Hydron Scarlet BB Paste	5,000	....
Hydron Yellow NF	2,000	....
Immedial Direct Blue B	1,000	....
Indanthrene Blue 3G Paste	100	....
Indanthrene Blue 3G	510	....
Indanthrene Blue GCD Dbl	1,000	....
Indanthrene Blue RSP Triple Pdr	1,550	....
Indanthrene Golden Orange G	400	....
Indanthrene Golden Orange G sand free	950	....
Indanthrene Golden Orange G Dbl. Paste	1,500	....
Indanthrene Golden Orange RRT	3,850	....
Indanthrene Green B Dbl. for printing	100	....
Indanthrene Pink B Dbl. Paste	175	....
Indanthrene Pink BS Pdr	105	....
Indanthrene Red BN Extra	810	....
Indanthrene Violet BN Ex. Paste	300	....
Indanthrene Violet RR Ex. Pdr	100	....

Designation of Dye	Germany (lbs.)	Switz. (lbs.)
Indanthrene Yellow GP Pdr	600	....
Indocyanine B	100	....
Isamine Blue 8B	25	....
Isamine Blue R	125	....
Janus Red B	600	....
Janus Yellow G	500	....
Kiton Yellow S	....	1,100
Kryogene Violet 3RX	300	....
Lanasol Blue B	....	1,320
Lanasol Brown 2R	....	880
Lanasol Green G	....	116
Lanasol Orange G	....	847
Lanasol Orange RR	....	1,155
Lanasol Red G	....	55
Lanasol Yellow G	....	33
Leather Black BO	364	....
Light Green SF Yellowish	200	....
Metachrome Blue Black 2BX	500	....
Metachrome Olive 2G	10	....
Methyl Alkali Blue	25	....
Methyl Violet NFB	25	....
Methyl Violet 5R	5	....
Methyl Violet RL	5	....
Methylene Blue G Conc	85	....
Milling Yellow O	100	....
Modern Violet	....	1,200
Modern Violet N	....	220
Naphtha Chrome Violet R	....	660
Naphthamine Blue JEF	750	....
Naphthogene Blue B	1,000	....
Naphthol RL Paste	10	....
Naphtylomine Black 4B	50	....
Naphtylomine Black 6B	50	....
Neutral Violet O	5	....
New Claret RX	150	....
Night Blue	50	....
Nitrosamine Red Paste	30	....
Oil Yellow R	50	....
Paper Fast Bordeaux B	1,000	....
Patent Blue V	5,000	....
Patent Phosphine G	....	2,640
Patent Phosphine M	....	682
Patent Phosphine R	....	220
Peacock Blue Lake	270	....
Phosphine G	100	....
Phosphine G Conc	....	110
Phosphine 2G Conc	....	110
Phosphine 3G Conc	....	110
Phosphine 5G Conc	....	110
Phosphine R	100	....
Pluto Black A Extra	500	....
Pluto Black G	5	....
Pluto Brown 2G	900	....
Pluto Brown R Pdr	875	....
Polar Maroon V Conc	....	2,000
Pyrogene Green 3G	....	1,312
Rapid Fast Blue B Pdr	10	....
Rapid Fast Brown B Pdr	10	....
Rapid Fast Orange RG Paste	10	....
Rapid Fast Red B Paste	10	....
Rapid Fast Red BB Paste	10	....
Rapid Fast Red 3GL	10	....
Rapid Fast Red GZ Paste	10	....
Resorcin Brown F	250	....
Rheonine A Conc	51	....
Rhodamine G	500	....
Rhodamine 6GDN	200	....
Rhodamine 6GDN Extra	695	....
Rhoduline Sky Blue 3G	350	....
Rosanthrene B	....	154
Rosanthrene BN	....	906
Rosanthrene R	....	55
Rosanthrene RN	....	2,057
Rosanthrene Fast Red 7BL	....	1,375
Rosanthrene Orange R	....	1,100
Sericose L	500	....
Soluble Blue T	100	....
Sorbine Red BB	11	....
Sulphon Yellow 5G	100	....
Sulphur Pyrogene Green 3G	....	605
Tannin Orange R Pdr	100	....
Thioflavine T	230	....
Thioflavine TCN	775	....
Thio Indigo Rose RN Ex. Paste	100	....
Thional Brilliant Green GG	....	1,500
Triazol Orange G	....	1,100
Triazol Red 8B	....	2,310
Trisulphon Brown B	....	2,000
Vat Heliotrope R Dbl. for printing	200	....
Vat Pink B Extra	10	....
Victoria Blue B Base	200	....
Victoria Pure Blue BO	500	....
Victoria Navy Blue B	500	....
Violet PDH	....	220
Virdin S Pdr	5	....
Wool Black GR	2,000	....
Wool Fast Blue BL	100	....
Xylene Fast Light Yellow 2G	....	500
Xylene Light Yellow 2G	....	500
Zambesi Pure Blue 4B	100	....
Totals	130,386	47,406

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